A Buch.

TREATISE

OF

MUSICK

SPECULATIVE, PRACTICAL and HISTORICAL.

CONTAINING

An EXPLICATION of the Philosophical and Rational Grounds and Principles thereof;

The NATURE and OFFICE of the SCALE of MUSICK;

The whole ART of Writing NOTES;

And the General Rules of Composition.

WITH

A Particular ACCOUNT of the ANTIENT MUSICK, and a COMPARISON thereof with the MODERN.

By ALEXANDER MALCOLM, A. M.

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EBRIBAHSI

Secretary Pageriers and Historicate



JUNITE

The Natural Organist SCAL BOOK and A Solid

Jak Carto Offic La Maria Delb La A.

By ALELIANDER LA COLUMN A M



O D E

Power of MUSICK,

Inscrib'd to

Mr. MALCOLM,

AS'A

Monument of Friendship, By Mr. MITCHELL.

L

HEN Nature yet in Embrio lay,

Ere Things began to be,

The Almighty from eternal Day

Spoke loud his deep Decree:

The Voice was tuneful as his Love,

At which Creation forung, And all th' Angelick Hofts above The Morning Anthem fung.

II. At

a 2

At Musick's sweet prevailing Call,
Thro' boundless Realms of Space,
The Atoms danc'd, obsequious all,
And, to compose this wondrous Ball,
In Order took their Place.
How did the Piles of Matter part,
And huddled Nature from her Slumber start?
When, from the Mass immensely steep,
The Voice bid Order sudden leap,
To usher in a World.
What heavenly Melody and Love
Began in ev'ry Sphere to move?
When Elements, that jarr'd before,
Were all aside distinctly hurl'd,
And Chaos reign'd no more.

III.

Musick the mighty Parent was,
Empower'd by God, the sovereign Cause.

Musick first spirited the lifeless Waste,
Sever'd the fullen, bulky Mass,
And active Motion call'd from lazy Rest.
Summon'd by Musick, Form uprear'd her Head,
From Depths, where Life it self lay dead,

While fudden Rays of everliving Light Broke from the Abyss of ancient Night, Reveal'd the new-born Earth around and its fair

Influence spread.

The Work, the Effect of Harmony, its wondron. Offsprings flood.

IV. Musick

IV.

Musick, the best of Arts divine,
Maintains the Tune it first began,
And makes ev'n Opposites combine
To be of Use to Man.
Discords with tuneful Concords move
Thro' all the spacious Frame;
Below is breath'd the Sound of Love,
While mystick Dances shine Above,
And Musick's Power to nether Worlds proclaim,
What various Globes in proper Spheres,
Perform their great Creator's Will?
While never silent never still,
Melodiously they run,
Unhurt by Chance, or Length of Years,

V.

Around the central Sun.

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The little perfect World, call'd Man,
In whom the Diapason ends,
In his Contexture, shews a Plan
Of Harmony, that makes Amends,
By God-like Beauty that adorns his Race,
For all the Spots on Nature's Face.
He boasts a pure, a tuneful Soul,
That rivals the celestial Throng,
And can ev'n savage Beasts controul
With his inchanting Song.
Tho' diff'rent Passions struggle in his Mind;
Where Love and Hatred, Hope and Fear as a joyn'd.
All, by a sacred Guidance, tend

All, by a facred Guidance, tend To one harmonious End.

VI. Its

VI.

Its great Original to prove,
And shew it bless'd us from above,
In creeping Winds, thro' Air it sweetly flotes,
And works strange Miracles by Notes.
Our beating Pulses bear each bidden Part,
And ev'ry Passion of the master'd Heart

Is touch'd with Sympathy, and speaks the Wonders of the Art.

Now Love, in fost and whispering Strains, Thrills gently thro' the Veins, And binds the Soul in silken Chains. Then Rage and Fury fire the Blood,

And hurried Spirits, rising high, ferment the boiling Flood;

Silent, anon, we fink, refign'd in Grief:
But ere our yielding Passions quite subside,
Some swelling Note calls back the ebbing
Tide,

And lifts us to Relief.

With Sounds we love, we joy, and we despair, The folid Substance hug, or grasp delusive Air.

VII.

In various Ways the Heart-strings shake,
And different Things they speak.
For, when the meaning Masters strike the
Lyre,

Or Hautboys briskly move,

Our Souls, like Lightning, blaze with quick Desire,

Or melt away in Love.
But when the martial Trumpet, swelling high,
Rolls

vii

Rolls its shrill Clangor thro' the ecchoing Sky;

If, answering hoarse, the sullen Drum's big Beat

Does, in dead Notes, the lively Call repeat; Bravely at once we break o'er Nature's Bounds; Snatch at grim Death, and look, unmov'd, on Wounds.

Slumb'ring, our Souls lean o'er the trembling Lute;

Softly we mourn with the complaining Flute; With the Violin laugh at our Foes,

By Turns with the Organ we bear on the Sky; Whilst, exulting in Triumph on Æther we fly,

Or, falling, grone upon the Harp, beneath a Load of Woes.

Each Instrument has magick Power, To enliven or destroy,

To fink the Heart, and, in one Hour, Entrance our Souls with Joy.

At ev'ry Touch, we lose our ravish'd Thoughts,' And Life, it felf, in quivering clings, hangs o'er the varied Notes.

VIII.

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How does the starting Treble raise
The Mind to rapt rous Heights;
It leaves all Nature in Amaze,
And drowns us with Delights.
But, when the manly, the majestick, Bass
Appears with awful Grace,

What

What folemn Thoughts are in the Mind infus'd?

And how the Spirit's rous'd?

In flow-plac'd Triumph, we are led around,
And all the Scene with haughty Pomp is
crown'd;

Till friendly Tenor gently flows,
Like fweet, meandring Streams,
And makes an Union, as it goes,
Betwixt the Two Extremes.
The blended Parts in That agree,
As Waters mingle in the Sea,
And yield a Compound of delightful Melody.

IX.

Strange is the Force of modulated Sound That, like a Torrent, fweeps o'er ev'ry Mound! It tunes the Heart at ev'ry Turn; With ev'ry Moment gives new Passions Birth; Sometimes we take Delight to mourn; Sometimes enhance our Mirth. It fooths deep Sorrow in the Breaft; It luls our waking Cares to Reft, Fate's clouded Brow ferenes with Eafe, And makes ev'n Madness please. As much as Man can meaner Arts controul, It manages his mafter'd Soul, The most invet'rate Spleen disarms, And, like Aurelia, charms: Aurelia! dear distinguish'd Fair! In whom the Graces center'd are! Whose Notes engage the Ear and Mind, As Violets breath'd on by the gentle Wind; Whose Beauty, Musick in Disguise!

Attracts the gazing Eyes,

Thrills thro' the Soul, like Haywood's melting Lines,

And, as it certain Conquest makes, the savage Soul refines.

X.

Musick religious Thoughts inspires, And kindles bright poetick Fires; Fires! such as great Hillarius raise Triumphant in their Blaze!

Amidst the vulgar versifying Throng, His Genius, with Distinction, show,

And o'er our popular Metre lift his Song High, as the Heav'ns are arch'd o'er Orbs below.

As if the Man was pure Intelligence,

Musick transports him o'er the Heights of Sense,

Thro' Chinks of Clay the Rays above lets in, And makes Mortality divine.

Tho' Reason's Bounds it ne'er defies,

Its Charms elude the Ken Of heavy, gross-ear'd Men,

Like Mysteries conceal'd from vulgar Eyes.

Others may that Distraction call,

Which Musick raises in the Breast,

To me 'tis Extafy and Triumph all,

The Foretastes of the Raptures of the Blest.

Who knows not this, when Handel plays; And Senefino lings?

Our

Our Souls learn Rapture from their Lays, While rival'd Angels show Amaze, And drop their golden Wings.

XI.

Still, God of Life, entrance my Soul With fuch Enthusiastick Joys; And, when grim Death, with dire Controul,

My Pleasures in this lower Orb destroys,
Grant this Request whatever you deny,
For Love I bear to Melody,
That, round my Bed, a facred Choir
Of skilful Masters tune their Voice,
And, without Pain of agonizing Strife,

In Confort with the Lute conspire,
To untie the Bands of Life;
That, dying with the dying Sounds
My Soul, well tun'd, may raise
And break o'er all the common Bounds
Of Minds, that grovel here below the Skies.

XII.

When Living die, and dead Men live,
And Order is again to Chaos hurl'd,
Thou, Melody, shalt still survive,
And triumph o'er the Ruins of the World.
A dreadful Trumpet never heard before,
By Angels never blown, till then,
Thro' all the Regions of the Air shall rore
That Time is now no more:
But lo! a different Scene!
Eternity appears,

Like

Like Space unbounded and untold by Years. High in the Seat of Happiness divine Shall Saints and Angels in full Chorus joyn.

In various Ways, Seraphick Lays

The unceasing Jubile shall crown,
And, whilst Heav'n ecchoes with his Praise,
The Almight v's self shall hear, and look,
delighted, down.

XIII.

Who would not wish to have the Skill
Of tuning Instruments at Will?
Ye Pow'rs, who guide my Actions, tell
Why I, in whom the Seeds of Musick
dwell,

Who most its Pow'r and Excellence admire Whose very Breast, it self's, a Lyre, Was never taught the heav'nly Art Of modulating Sounds,

And can no more, in Confort, bear a Part Than the wild Roe, that o'er the Mountains bounds?

Could I live o'er my Youth again,
(But ah! the Wish how idly vain!)
Instead of poor deluding Rhime,
Which like a Syren murders Time,
Instead of dull, scholastick Terms,
Which made me stare and fancy Charms;
With Gordon's brave Ambition fir'd,
Beyond the tow'ring Alps, untir'd,

To tune my Voice to his fweet Notes, I'd

Or fearch the Magazines of Sound, Where Musick's Treasures ly profound, With M---- here at Home.

M—, the dear, deferving Man,
Who taught in Nature's Laws,
To fpread his Country's Glory can
Practife the Beauties of the Art, and shew its
Grounds and Cause.





Sordord's array & ministra



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Counterpoint.

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INTRODUCTION.

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n 2.

Have no fecret History to entertain my Reader with, or rather to be impertinent with, concerning the Occasion of my studying, writing, or publishing any Thing upon this

Subject: If the Thing is well done, no matter how it came to pass. And tho' it be somewhat unfastionable, I must own it, I have no Apology to make: My Lord Shaftshury, indeed, assures me, that the Generality of Readers are not a little raised by the Submission of a confessing Author, and very ready on these Terms to give him Absolution, and receive him into their good Grace and Favour; whatever may be in it, I have Nothing of this Kind wherewith to bribe their Friendship; being neither conscious of Lazines, Precipitancy, or any other wisful Vice, in the Management of this Work, that should give me great Uneasiness about it; if there be a Fault, it lies somewhere else, for, to be plain, I have taken all the Pains I could.

0 2

I have always thought it as impertinent for an Author to offer any Performance to the World, with a flat Pretence of suspecting it, as it is ridiculous to commend himself in a conceited and faucy Manner; there is certainly fomething just and reasonable, that lies betwixt these Extremes; perhaps the best Medium is to say Nothing at all; but if one may speak, I think he may with a very good Grace fay, he has defigned well and done his best; the Respect due to Mankind requires it, and as I can fincerely profess this, I shall have no Anxiety about the Treatment my Book may meet with. The Criticks therefore may take their full Liberty: I can lose Nothing at their Hands, who examine Things with a true Respect to the real Service of Mankind; if they approve, I shall rejoyce, if not, I shall be the better for their judicious Correction: And for those who may judge rashly thro' Pride or Ignorance, I shall only pity them.

I would beg Leave to confider a little. Some People, as foon as they hear of a new Book upon a known Subject, ask what Discovery the Author has made, or what he can say, which they don't know or cannot find elsewhere? I might desire these curious Gentlemen to read and see; but that they may better understand my Pretences, and where to lay their Censures, let them consider, there are Two Kinds of Discoveries in Sciences; one is that of new Theorems and Propositions, the other is of the proper Res

Relation and Connection of the Things already found, and the easy Way of representing them to the Understanding of others; the first affords the Materials, and the other the Form of these intellectual Structures which we call Sciences: How useless the first is without the other, needs no Proof; and what an Odds there may be in the Way of explaining and disposing the Parts of any Subject, we have a Thousand Demonstrations in the numerous Writings upon every Subject. An Author, who has made a Science more intelligible, by a proper and distinct Explication of every fingle Part, and a just and natural Method in the Connection of the Whole; tho' he has faid Nothing, as to the Matter, which was not before discovered, is a real Benefactor to Mankind: And if he has gathered together in one System, what, for want of knowing or not attending to their true Order and Dependence, or whatever other Reason, lay scattered in feveral Treatifes, and perhaps added many useful Reflections and Observations; will not this Author, do ye think, be acquitted of the Charge of Plagiarism, before every reasonable Judge; and be reckoned justly more than a mere Collector, and to have done fomething new and useful? If you appeal to a very wife and learned ANCIENT, the Question is clearly determined. - Etiamsi omnia a veteribus inventa sunt, tamen erit boc semper novum, usus & dispositio inventorum ab aliis. SENECA Ep. 64. How far this Character of a new Author will be found in the following TREATISE, depends

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pends upon the Ability and Equity of my Judg-

es, and I leave it upon their Honour.

Bur you must have Patience to hear another Thing, which Justice demands of me in this Place. It is, to inform you, that the 13 Ch. of the following Book was communicated to me by a Friend, whose Modesty forbids me to name. The speculative Part, and what else there is, besides the Subject of that Chapter, were more particularly my Study: But I found, there would certainly be a Blank in the Work, if at least the more general Principles of Compolition were not explained; and whatever Pains I had taken to understand the Writers on this Branch, yet for want of fufficient Practice in it, I durst not trust my own Judgment to extract out of them tuch a Compend as would anfwer my Defign; which I hope you will find very happily supplied, in what my Friend's Genius and Generosity has afforded: And if I can judge any Thing about it, you have here not a mere Compend of what any Body else has done, but the first Principles of harmonick Composition explained in a Manner peculiarly his own.

AFTER so long a personal Conference, you'll perhaps expect I should say something, in this Introduction, to my Subject; but this, I believe, will be universally agreeable, the Experience of some Thousand Years giving it sufficient Recommendation; and for any Thing else I have little to say in this Place. The Contents you have in the preceeding Table, and I shall only make

this fhort Transition to the Book it felf.

THE

Of the Original and various Significations of the Word Musick, you'll have an Account in the Beginning of Chap. 14. For, an historical Account of the antient Musick being one Part of my Design, I could not begin it better, than with the various Use of the Name among the Antients. It shall be enough therefore to tell you here, that I take it in the common Sense, for that Science which considers and explains those Properties and Relations of Sounds, that make them capable of exciting the agreeable Sensations, which the Experience of all Mankind affures us to be a natural Effect of certain Applications of them to the Ear. And for the same Reason I forbear to speak, in this Place, any Thing particularly of the Antiquity, Excellency, and various Uses and Ends of Mufick, which I shall at large consider in the forementioned Chapter, according to the Sentiments and Experience of the Antients, and how far the Experience of our Times agrees with that,

Corrigenda.

Page 52. l. 16. read 3: 2. p. 55, l. 3. D. r, C. p. 76. l. 32. two r. one. l. 33. fundamental r. acute Term. p. 77. l. 2. 2. r. 1. acute Term r. fundamental. p. 125. l. 24. r. $\frac{3}{5}$ by $\frac{2}{3}$. p. 146, l. 11. r. 2: 3. p. 158. l. 5. 3. r. 2. p. 227. l. 18. r. in harmonical (as one Word) p. 256. l. 1. r. C-c. l. 5. D. r. d. p. 295. l. 14. b r. b. p. 301. l. 11. r. Plate 2 Fig. 2. p. 319.

p. 319. l. 26. Tune or r. human. l. 30. dele in. p. 341. l. 11. a r. or. p. 356. l. 27. g#, eb. r. ab, d#. p. 435. l. 7. the r. in the. p. 452. l. 29. dele other. p. 458. l. 22. are r. is. l. 23. least r. best. p. 550. l. 10. Objects r. Subjects.

Pray excuse a few smaller Escapes which the

Sense will easily correct.

Addenda.

Page 408. l. 8. after Bar, add, or of any particular Note. p. 411 l. 1. after Crotchets, add, in the Triples \(\frac{6}{4} \) \(\frac{1}{4} \) p. 413. add at the End; and if b or \(\pi \) is annexed to these Figures, it signifies lesser or greater, so 3\(\pi \) is 3dg, and 6\(\pi \) is 6tbl. p. 413. l. 21. after Example, add Plate 4. and mind, that all the Examples of Plates 4, 5, 6. belong to the 13 Chap. p. 485. l. 11. after Memory, add, we have a very old and remarkable Proof of this Virtue of Musick.

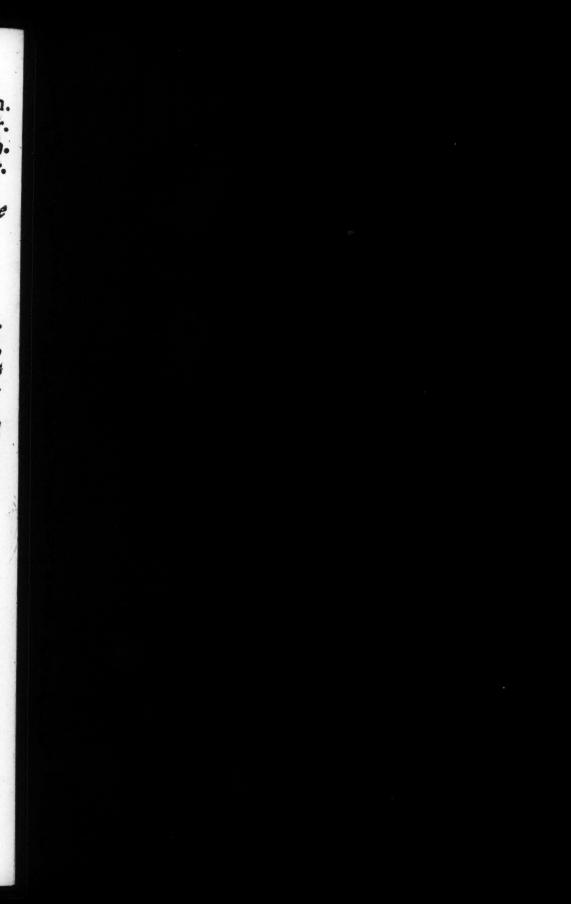
N. B. In the Table of Examples Page 258. the different Characters of Letters are neglected; but the Numbers of each Example will discover what they ought to be, in Conformity to Fig. 5. Plate 1. from

whence they are taken.

N. B. See Page 50. at Line 7. and consequently, &c. A wrong Conclusion has here escaped me, viz. that since the Chord passes the Point O, therefore it is accelerated. I own the only Thing that follows from its passing that Point is, that the Chord in every Point d. (of a single Vibration) has more Force than would retain it there: And the true Reason of Acceleration, is this, viz. in the outmost Point D. it has just as much Force as is equal to what would keep it there: This Force is supposed not to be destroyed, but at the next Point d. to receive an Addition of as much as would keep it in that Point, and so on through every Point till it pass the straight Line, and that it loses its Force by the same Degrees; from whence follows the Law of Acceleration mentioned.

N. B. See Plate 6. Example 35. the 2d, 3d, 4th, 5th, and 6th Notes

of the Bass ought to be each a Degree lower.



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TREATISE

OF

MUSICK.

CHAP. I.

Containing an Account of the Object and End of Musick, and the Nature of the Science, in the Definition and Division of it.

§ 1. Of Sound: The Cause of it; and the various Affections of it concerned in Musick.



whose End is Pleasure. Sounds, whose End is Pleasure. Sound is the Object in general; or, to speak with the Philosophers, it is the material Object. But it is not the Business of Musick,

taken in a strict and proper Sense, to consider every Phenomenon and Property of Sound; that belongs to a more universal Philosophy: Yet, that we may understand what it is in Sounds

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upon which the Formality of Musick depends, i. a. whereby it is distinguished from other Sciences, of which Sound may also be the Object: Or, What it is in Sounds that makes the particular and proper Object of Musick, whereby it obtains its End; we must a little consider the Nature of Sound.

Sound is a Word that stands for every Perception that comes by the Ear immediately. And for the Nature of the Thing, it is now generally agreed upon among Philosophers, and also confirmed by Experience, to be the Effect of the mutual Collision, and consequent tremulous Motion in Bodies communicated to the circumambient Fluid of Air, and propagated

thre' it to the Organs of Hearing.

A Treatife that were defigned for explaining the Nature of Sound univerfally, in all its known and remarkable Phanomena, should, no doubt, examine very particularly every Thing that belongs to the Cause of it; First, The Nature of that Kind of Motion in Bodies (excited by their mutual Percussion) which is communicated to the Air; then, how the Air receives and propagates that Motion to certain Distances: And, lastly, How that Motion is received by the Ear, explaining the several Parts of that Organ, and their Offices, that are employed in *Hearing*. But as the Nature and Dengn of what I propose and have essayed in this Treatife, does not require fo large an Account of Sounds, I must be content only to conider fuch Phanomena as belong properly to Musick,

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Musick, or serve for the better Understanding of it. In order to which I shall a little further enlarge the preceding general Account of the

Cause of Sound. And,

First, That Motion is necessary in the Production of Sound, is a Conclusion drawn from all our Experience. Again, that Motion exists, first among the small and insensible Parts of such Bodies as are Sonorous, or capable of Sound; excited in them by mutual Collision and Percusfion one against another, which produces that tremulous Motion so observable in Bodies, especially that have a free and clear Sound, as Bells. and the Strings of musical Instruments; then, this Motion is communicated to, or produces a like Motion in the Air, or fuch Parts of it as are apt to receive and propagate it: For no Motion of Bodies at Distance can affect our Senses, (or move the Parts of our Bodies) without the Mediation of other Bodies, which receive thefe Motions from the Sonorous Body, and communicate them immediately to the Organs of Sense; and no other than a Fluid can reasonably be supposed. But we know this also by Experience; for a Bell in the exhansted Receiver of an Airpump can scarcely be heard, which was loud enough before the Air was drawn out. In the last Place, This Motion must be communicated to those Parts of the Ear that are the proper and immediate Instruments of Hearing. The Mechanism of this noble Organ has still great Difficulties, which all the Industry of the most capable and curious Enquirers has not furmounted: There A 2

There are Questions still unfolved about the Use of some Parts, and perhaps other necessary Parts never yet discovered: But the most important Question among the Learned is about the last and immediate Instrument of Hearing, or that Part which last receives the fonorous Motion. and finishes what is necessary on the Part of the Organ. Confult these with the Philosophers and Anatomists; I shall only tell you the com-mon Opinion, in such general Terms as my Defign permits, thus: Next to the external visible Cavity or Passage into the Ear, there is a Cavity, of another Form, separate from the former by a thin Membrane, or Skin, which is called the Tympan or Drum of the Ear, from the Refemblance it has to that Instrument: Within the Cavity of this Drum there is always Air, like that external Air which is the Medium of Sound. Now, the external Air makes its Impression first on the Membrane of the Drum, and this communicates the Motion to the internal Air, by which it is again communicated to other Parts, till it reaches at last to the auditory Nerve, and there the Sensation is finished, as far as Matter and Motion are concerned; and then the Mind, by the Laws of its Union with the Body, has that Idea we call Sound. It is a curious Remark, that there are certain Parts fitted for the bending and unbending of the Drum of the Ear, in order, very probably, to the perceiving Sounds that are raifed at greater or lesser Distances, or whose Motions have different Degrees of Force, like what we are more fenfible

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fensible of in the Eye, which by proper Muscles (which are Instruments of Motion) we can move outwards or inwards, and change the very Figure of, that we may better perceive very distant or near Objects. But I have gone far e-

nough in this.

LEST what I have faid of the Cause of Sound be too general, particularly with respect to the Motion of the fonorous Body, which I call the original Cause, let us go a little farther with it. That Motion in any Body, which is the immediate Cause of its sounding, may be owing to two different Causes; one is, the mutual Percussion betwixt it and another Body, which is the Case of Drums, Bells, and the Strings of musical Instruments, &c. Another Cause is, the beating or dashing of the sonorous Body and the Air immediately against one another, as in all Kind of Wind-instruments, Flutes, Trumpets, Hautboys, &c. Now in all these Cases, the Motion which is the Confequence of the mutual Percussion betwixt the whole Bodies, and is the immediate Cause of the sonorous Motion which the Air conveys to our Ears, is an invisible tremulous or undulating Motion in the small and insensible Parts of the Body. To explain this;

All visible Bodies are supposed to be compofed of a Number of small and infensible Parts, which are of the fame Nature in every Body, being perfectly hard and incompressible: Of these infinitely little Bodies are composed others that are fomething greater, but still insensible, and these are different, according to the different Figures'

and Union of their component Parts: These are again supposed to constitute other Bodies greater, (which have greater Differences than the last) whose different Combinations do, in the last Place, constitute those gross Bodies that are visible and touchable. The first and smallest Parts are absolutely hard; the others are compresfible, and are united in fuch a Manner, that being, by a fufficient external Impulse, compressed, they restore themselves to their natural, or ordinary, State: This Compression therefore happening upon the Shock or Impulse made by one Body upon another, these small Parts or Particles, by their restitutive Power (which we also call elastick Faculty) move to and again with a very great Velocity or Swiftness, in a tremulous and undulating Manner, something like the visible Motions of grosser Springs, as the Chord of a musical Instrument; and this is what we may call the Sonorous Motion which is propagated to the Ear. But observe that it is the infentible Motion of these Particles next to the fmallest, which is supposed to be the immediate Cause of Sound; and of these, only those next the Surface can communicate with the Air; their Motion is performed in very fmall Spaces, and with extreme Velocity; the Motion of the Whole, or of the greater Parts being no further concerned than as they contribute to the other, And this is the Hypothesis upon which Monsieur

Perrault of the Royal Society in France, explains the Nature and Ph.enomena of Sound, in his curious Treatife upon that Subject, Essais de Physique;

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Tom. II. Du Bruit. How this Theory is supported I shall briefly shew, while I consider a

few Applications of it.

OF those hard Bodies that found by Percussion of others, let us consider a Bell: Strike it with any other hard body, and while it founds we can difcern a fenfible Tremor in the Surface, which fpreads more fenfibly over the Whole, as the Shock is greater. This Motion is not only in the Parts next the Surface, but in all the Parts thro' the whole Solidity, because we can perceive it also in the inner Surface of the Bell. which must be by Communication with those Parts that are immediately touched by the striking Body. And this is proven by the ceasing of the Sound when the Bell is touched in any other Part; for this shews the easy and actual Communication of the Motion. Now this is plainly a Motion of the feveral small and insensible Parts changing their Situations with refpect to one another, which being fo many, and fo closely united, we cannot perceive their Motions feparately and distinctly, but only that Trembling which we reckon to be the Effect of the Confusion of an infinite Number of little Particles fo closely joyned and moving in infinitely finall Spaces. Thus far any Body will eafily go with the Hypothesis: But Monsieur Perrault carries it farther, and affirms, That that visible Motion of the Parts is no otherwife the Caufe of the Sound, than as it causes the invisible Motion of the yet smaller Parts, (which he calls Particles, to distinguish them from the other which he calls

calls Parts, the least of all being with him Corpuscles.) And this he endeavours to prove by other Examples, as of Chords and Wind-instru-

ments. Let us consider them.

TAKE a Chord or String of a Musical Instrument, stretched to a sufficient Degree for Sounding; when it is fixt at both Ends, we make it found by drawing the Chord from its straight Position, and then letting it go; (which has the same Effect as what we properly call Percussion) the Parts by this drawing, whereby the Whole is lengthned, being put out of their natural State, or that which they had in the straight Line, do by their Elasticity restore themselves, which causes that vibratory Motion of the Whole, whereby it moves to and again beyond the straight Line, in Vibrations gradually smaller, till the Motion cease, and the Chord recover its former Position. Now the shorter the Chord is, and the more it is stretched in the straight Line, the quicker these Vibrations are: But however quick they are, Monsieur Perrault denies them to be the immediate Cause of the Sound; because, fays he, in a very long Chord, and not very fmall, firetched only fo far as that it may give a distinct Sound, we can perceive with our Eye, besides the Vibrations of the whole Chord. a more confused Tremor of the Parts, which is more difcernible towards the Middle of the Chord, where the Parts vibrate in greater Spaces in the Motion of the Whole; this last Motition of the Parts which is caused by the first Vibrations of the Whole, does again occasion a Motion

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Motion in the leffer Parts or Particles, which is the immediate Cause of the Sound. And this he endeavours to confirm by this Experiment, viz. Take a long Chord (he fays he made it with one of 30 Foot) and make it found; then wait till the Sound quite cease, and then also the vifible Undulations of the whole Chord will cease: If immediately upon this ceasing of the Sound, you approach the Chord very foftly with the Nail of your Finger, you'll perceive a tremulous Motion in it, which is the remaining fmall Vibrations of the whole Chord, and of the Parts caused by the Vibrations of the Whole. Now these Vibrations of the Parts are not the immediate Cause of Sound; else how comes it that while they are yet in Motion they raise no Sound? The Answer perhaps is this, That the Motion is become too weak to make the Sound to be heard at any great Distance. which might be heard were the Tympan of the Ear as near as the Nail of the Finger, by which we perceive the Motion. But to carry off this, Mr. Perrault fays, That as foon as this finall Motion is perceived, we shall hear it found; which is not occasioned by renewing or augmenting the greater Vibrations, because the Finger is not supposed to strike against the Chord, but this against the Finger, which ought rather to stop that Motion; the Cause of this renewed Sound therefore is propably, That this weak Motion of the Parts, which is not fufficient to move the Particles (whose Motion is the First that ceases) receives some Assistance from the dashing

dashing against the Nail, whereby they are enabled to give the Particles that Motion which is necessary for producing the Sound. But left it should still be thought, that this Encounter with the Nail may as well be supposed to increase the Motion of the Parts to a Degree fit for founding, as to make them capable of moving the Particles; we may confider, That the Particles being at Rest in the Parts, and having each a common Motion with the whole Part, may very eafily be supposed to receive a proper and particular Motion by that Shock; in the same Manner that Bodies which are relatively at Rest in a Ship, will be shaked and moved by the Shock of the Ship against any Body that can any thing confiderably oppose its Motion. Now for as simple as this Experiment appears to be, I am afraid it cannot be fo eafily made as to give perfect Satisfaction, because we can hardly touch a String with our Nail but it will found.

But Mr. Perrault finishes the Proof of his Hypothesis by the Phenomena of Wind-instruments. Take, for example, a Flute; we make it sound by blowing into a long, broad, and thin Canal, which conveys the Air thrown out of the Lungs, till 'tis dashed against that thin solid Part which we call the Tongue, or Wind-cutter, that is opposite to the lower Orifice of the foresaid Canal; by which Means the Particles of that Tongue are compressed, and by their restitutive Motion they communicate to the Air a Sonorous Motion, which being immediately thrown an gainst the inner concave Surface of the Flute, and

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and moving its Particles, the Motion communicated to the Air, by all these Particles both of the Tongue and inner Surface, makes up the

whole Sound of the Flute.

Now to prove that only the very fmall Particles of the inner Surface and Edge of the Tongue are concerned in the Sound of the Flute, we must consider, That Flutes of different Matter, as Metal, Wood, or Bone, being of the fame Length and Bore, have none, or very little fensible Difference in their Sound; nor is this fenfibly altered by the different Thickness of the Flute betwixt the outer and inner Surface; nor in the last place, is the Sound any way changed by touching the Flute, even tho' it be hard pressed, as it always happens in Bells and other hard Bodies that found by mutual Percussion. All this Mr. Perrault accounts for by his Hypothesis, thus: He tells us, That as the Corpufcles are the same in all Bodies, the Particles which they immediately constitute, have very small Differences in their Nature and Form; and that the specifick Differences of visible Bodies, depend on the Differences of the Parts made up of these Particles, and the various Connections of thefe Parts, which make them capable of different Modifications of Motion. Now, hard Bodies that found by mutual Percussion one against another, owe their founding to the Vibrations of all their Parts, and by these to the infensible Motions of their Particles; but according to the Differences of the Parts and their Connections, which make

make them, either Silver, or Brass, or Wood, &c. fo are the Differences of their Sounds. But in Wind-instruments (for example, Flutes) as there are no fuch remarkable Differences answering to their Matter, their Sound can only be owing to the infentible Motion of the Particles of the Surface; for these being very little different in all Bodies, if we suppose the Sound is owing to their Motions only, it can have none, or very small Differences: And because we find this true in Fact, it makes the Hypothesis extremely probable. I have never indeed feen Flutes of any Matter but Wood, except of the small Kind we call Flageolets, of which I have feen Ivoryo nes, whose Sound has no remarkable Difference from a wooden one; and therefore I must leave so much of this Proof upon Monsieur Perrault's Credit. As to the other Part, which is no less considerable, That no Compression of the Flute can fensibly change its Sound, 'tis certain, and every Body can easily try it. To which we may add, That Flutes of different Matter are founded with equal Eafe, which could not well be if their Parts were to be moved; for in different Bodies these are differently moveable. But I must make an End of this Part, in which I think it is made plain enough, That the Motion of a Body which causes a founding Motion in the Air, is not any Motion which we can possibly give to the whole Body, wherein all the Parts are moved in one common Direction and Velocity; but it is the Motion of the feveral finall and undistinguishable Parts,

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Parts, which being compressed by an external Force, do, by their elastick Power, restore themselves, each by a Motion particular and proper to it self. But whether you'll distinguish Parts and Particles as Mr. Perrault does, I leave to your selves, my Design not requiring any accurate Determination of this Matter. And now to come nearer to our Subject, I shall next consider the Differences and Affections of Sounds that are

any way concerned in Musick.

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SOUNDS are as various, or have as many Differences, as the infinite Variety of Things that concur in their Production; which may be reduced to these general Heads: 1st, Quantity, Constitution, and Figure of the fonorous Body; with the Manner of Percussion, and the confequent Velocity of the Vibrations of the Parts of the Body and the Air; also their Equality and Uniformity, or Inequality and Irregularness. 2dly, The Constitution and State of the fluid Medium through which the Motion is propagated. 3dly, The Disposition of the Ear that receives that Motion. And, 4thly, The Distance of the Ear from the sonorous Body. To which we may add, lastly, the Consideration of the Obstacles that interpose betwixt the sonorous Body and the Ear; with other adjacent Bodies that, receiving an Impression from the Fluid for moved, react upon it, and give new Modification to the Motion, and confequently to the Sound. Upon all these do our different Perceptions of Sound depend,

THE Variety and Differences of Sounds, owing to the various Degrees and Combinations of the Conditions mentioned, are innumerable; but to our present Design we are to consider the

following Distinctions.

1. SOUNDS, come under a specifick Distinction, according to the Kinds of Bodies from which they proceed: Thus, Metal is easily distinguished from other Bodies by the Sound; and among Metals there is great difference of Sounds, as is discernible, for Example, Betwixt Gold, Silver, and Brass. And for the Purpose in hand, a most notable Difference is that of stringed and Wind-instruments of Musick, of which there are also Subdivisions: These Differences depend, as has been said, upon the different Constitutions of these Bodies; but they are not strictly within the Consideration of Musick, not the Mathematical Part of it at least, the they may be brought into the Practical; of which afterwards.

Sounds can be heard; by the fame Ear, at greater Distances than others; and when we are at the same Distance from two Sounds, I mean from the sound first rises, we can determine (for we learn it by Experience and Observation) which of the Two will be heard farthest: By this Comparison we have the Idea of a Disserence whose opposite Terms are called LOUD and LOW, (or strong and weak.) This Disserence depends both upon the Nature of disserent Bodies, and upon

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npon other accidental Circumstances, such as their Figure; or the different Force in the Percussion; and frequently upon the Nature of the circumsacent Bodies, that contribute to the strengthning of the Sound, that is a Conjunction of several Sounds so united as to appear only as one Sound: But as the Union of several Sounds gives Occasion to another Distinction, it shall be considered again, and we have only to observe here that it is always the Cause of Loudness; yet this Disserence belongs not strictly to the Theory of Musick, the it is brought into the Practice, as that in the First Article.

III. THERE is an Affection or Property of Sound, whereby it is diffinguished into Acure, sharp or high; and GRAVE, flat or low. The Idea of this Difference you'll get by comparing feveral Sounds or Notes of a mulical Instrument, or of a human Voice finging, Observe the Term, Low, is sometimes opposed to Loud, and sometimes to acute, which yet are very different Things: Loudness is very well measured by the Distance or Sphere of Audibility, which makes the Notion of it very clear. Acuteness is so far different, that a Voice or Sound may ascend or rife in Degree of Acuteness, and yet lose nothing of its Loudness, which can easily be demonstrated upon any Instrument, or even in the Voice; and particularly if we compare the Voice of a Boy and a Man.

THIS Relation of Acuteness and Gravity is one of the principal Things concerned in Musick, the Nature of which shall be particularly

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confidered afterwards; and I shall here observe that it depends altogether upon the Nature of the fonorous Body it felf, and the particular Figure and Quantity of it; and in some Cases upon the Part of the Body where it is struck. So that, for Example, the Sounds of two Bells of different Metals, and the same Shape and Dimensions, being struck in the same Place, will differ as to Acuteness and Gravity; and two Bells of the same Metal will differ in Acutenels, if they differ in Shape or in Magnitude, or be Aruck in different Parts: So in Chords, all other Things being equal, if they differ either in Matter, or Dimensions, or the Degree of Ten-sion, as being stretched by different Weights, they will also differ in Acuteness.

BUT we must carefully remark, That Acuteness and Gravity, also Loudness and Lowness are but relative Things; fo that we cannot call any Sound acute or loud, but with respect to another which is grave or low in reference to the former; and therefore the fame Sound may be acute or grave, also loud or low in different Respects. Again, These Relations are to be found not only between the Sounds of different Bodies, but also between different Sounds of the same Body; for different Force in the Percusfion will cause a louder or lower Sound, and Ariking the Body in different Parts will make an acuter or graver Sound, as we have remarkably demonstrated in a Bell, which as the Stroke is greater gives a greater or louder Sound, and being struck nearer the open End, gives

gives the graver Sound. How these Degrees are measured, we shall learn again, only mind that these Degrees of Acuteness and Gravity are also called different and distinguishable Tones or Tunes of a Voice or Sound; fo we fay one Sound is in Tune with another when they are in the same Degree: Acute and Grave being but Relations, we apply the Name of Tune to them both, to express something that's constant and absolute which is the Ground of the Relation; in like manner as we apply the Name Magnitude both to the Things we call Great and Little, which are but relative Idea's: Each of them have a certain Magnitude, but only one of them is great and the other little when they are compared; fo of Two Sounds each has a certain Tune, but only one is acute and the other grave in Comparison.

IV. THERE is a Distinction of Sounds, whereby they are denominated long or short; which relates to the Duration, or continued, and fenfibly uninterrupted Existence of the Sound. This is a Thing of very great Importance in Mufick; but to know how far, and in what respect it belongs to it, we must distinguish betwixt the natural and artificial Duration of Sound. I call that the natural Duration or Continuity of Sound, which is less or more in different Bodies, owing to their different Constitutions, whereby one retains the Motion once received longer han another does; and confequently the Sound continues longer (tho' gradually weaker) after he external Impulse ceases; so Bells of different Metals, all other Things being equal and alike

alike, have different Continuity of Sound after the Stroke: And the fame is very remarkable in Strings of different Matter: There is too a Difference in the same Bell or String, according to the Force of the Percussion. This Continuity is fometimes owing to the fudden Reflection of the Sound from the Surface of neighbouring Bodies; which is not fo properly the fame Sound continued, as a new Sound fucceeding the First fo quickly as to appear to be only its Continuation: But this Duration of Sound does not properly belong to Musick, wherefore let us consider the other. The artificial Continuity of Sound is, that which depends upon the continued Impulse of the efficient Cause upon the fonorous Body for a longer or shorter Time. Such are the Notes of a Voice, or any Wind-instrument, which are longer or shorter as we continue to blow into them; or, the Notes of a Violin and all string'd Instruments that are struck with a Bow, whose Notes are made longer or shorter by Strokes of different lengths or Quickness of Motion; for a long Stroke, if it is quickly drawn, may make a shorter Note than ashort Stroke drawn flowly. Now this kind of Continuity is properly the Succession of several Sounds, or the Effect of feveral distinct Strokes, or repeated Impulses, upon the sonorous Body, so quick that we judge it to be one continued Sound, especially if it is continued in one Degree of Strength and Loudness; but it must also be continued in one Degree of Tune, else it cannot be called one Note in Musick. And this leads me natural0

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ly to consider the very old and notable Distinction of a twofold Motion of Sound, thus.

Sound may move thro' various Degrees of Acuteness in a continual Flux, so as not to rest on any Degree for any affignable, or at least fenfible Time; which the Ancients called the continuous Motion of Sound, proper only to Speaking and Conversation. Or, 2do. it may pass from Degree to Degree, and make a fensible Stand at every Pitch, fo as every Degree shall be distinct; this they called the discrete or discontinued Motion of Sound, proper only to Mulick or Singing. But that there may be no Obscurity here, consider, That as the Idea's of Motion and Distance are inseparably connected, so they belong in a proper Sense to Bodies and Space; and whatever other Thing they are applied to, it is in a figurative and metaphorical Sense, as here to Sounds; yet the Application is very intelligible, as I shall explain it. Voice or Sound is confidered as one individual Being, all other Differences being neglected except that of Acuteness and Gravity, which is not confidered as constituting different Sounds, but different States of the fame Sound; which is eafy to conceive: And fo the feveral Degrees or Pitches of Tune, are considered as several Places in which a Voice may exist. And when we hear a Sound fucceffively existing in different Degrees of Tune, we conceive the Voice to have moved from the one Place to the other; and then 'tis eafy to conceive a Kind of Distance between the two Degrees or Places; for as Bodies are faid to be distant, between which other Bodies may be placed, fo two Sounds are faid to be at Distance, with respect to Tune, between which other Degrees may be conceived, that shall be acute with respect to the one, and grave with respect to the other. But when the Voice continues in one Pitch, tho' there may be many Interruptions and fensible Rests whereby the Sound doth end and begin again, yet there is ho Motion in that Cafe, the Voice being all the Time in one Place. Now this Motion, in a fimple and proper Sense, is nothing else but the fuccessive Existence of several Sounds differing in Time. When the fuccessive Degrees are to near that like the Colours of a Rainbow, they are as it were lost in one another, so that in any sensible Distance there is an indefinite Number of Degrees, fuch kind of Succession is of no use in Musick; but when it is such that the Ear is Judge of every fingle Difference, and can compare several Differences, and apply some known Measure to them, there the Object of Musick does exift; or when there is a Succession of feveral Sounds distinct by sensible Rests, tho' all in the same Tune, fuch a Succession belongs also to Musick.

We fee a twofold Continuity of Sound, both subject to certain and determinate Measures of Duration; the one is that arising from the continuous Motion mentioned, which has nothing to do in Musick; the other is the Continuity or uninterrupted Existence of Sound in

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one Degree of Tune. The Differences Sounds in this respect, or the various Measures of long and short, or, (which is the same, at least a Consequence) swift and slow, in the fuccessive Degrees of Sound, while it moves in the fecond Manner, make a principal and necessary Ingredient in Musick; whose Effect is not inferior to any other Thing concerned in the Practice; and is what deferves to be very particularly considered, the' indeed it is not brought under so regular and determinate Rules as the

Differences of Tune.

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V. Sounds are either simple or compound; but there is a twofold Simplicity and Composition to be considered here; the First is the same with what we explain'd in the last Article, and relates to the Number of fuccessive Vibrations of the Parts of the fonorous Body, and of the Air, which come so fast upon the Ear that we judge them all to be one continued Sound, tho' it is really a Composition of several Sounds of shorter Du-And our judging it to be one, is very well compared to the Judgment we make of that apparent Circle of Fire, caused by putting the fired End of a Stick into a very quick circular Motion; for suppose the End of the Stick in any Point of that Circle which it actually describes, the Idea we receive of it there continues till the Impression is renewed by the sudden Return; and this being true of every Point, we must have the Idea of a Circle of Fire; the only Difference is, that the End of the Stick has actually existed in every Point of the Circle, whereas

whereas the Sound has had Interruptions, tho' infenfible to us because of their quick Succession; but the Things we compare are, the Succession of the Sounds making a fenfible Continuity with refpect to Time, and the Succession of the End of the Stick in every Point of the Circle after a whole Revolution; for 'tis by this we judge it to be a Circle, making a Continuity with respect to Space. The Author of the Elucidationes Physica upon D' Cartes Musick, illustrates it in this Manner, fays he, As standing Corns are bended by one Blast of Wind, and before they can recover themselves the Wind has repeated the B'ast, so that the Corn's standing in the same inclined Position for a certain Time, seems to be the Effect of one fingle Action of the Wind, which is truly owing to feveral diffinct Operations; in like Manner the fmall Branches (capillamenta) of the auditory Nerve, resembling so many Stalks of Corn, being moved by one Vibration of the Air, and this repeated before the Nerve can recover its Situation, gives Occasion to the Mind to judge the whole Effect to be one Sound. The Nature of this kind of Composition being fo far explain'd, we are next to confider what Simplicity in this Sense is; and I think it must be the Effect of one fingle Vibration, or as many Vibrations as are necessary to raise in us the Idea of Sound; but perhaps it may be a Question, Whether we ever have, or if we can raise such an Idea of Sound: There may be alfo another Question, Whether any Idea of Sound can exist in the Mind for an indivisible Space of

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of Time; the Reason of this Question is, That if every Sound exists for a finite Time, it can be divided into Parts of a shorter Duration, and then there is no fuch Thing as an absolute Simplicity of this Kind, unless we take the Notion of it from the Action of the external Cause of Sound, viz. the Number of Vibrations necesfary to make Sound actually exist, without confidering how long it exists; but as it is not probable that we can ever actually produce this, i. e. put a Body in a founding Motion, and stop it precifely when there are as many Vibrations finished as are absolutely necessary to make Sound, we must reckon the Simplicity of Sound, confidered in this Manner, and with respect to Practice, a relative Thing; that being only fimple to us which is the most simple, either with respect to the Duration or the Cause, that we ever hear: But whether we consider it in the repeated Action of the Cause or the confequent Duration, which is the Subject of the last Article, there is still another Simplicity and Composition of Sounds very different from that, and of great Importance in Musick, which I shall next explain.

A fimple Sound is the Product of one Voice or individual Body, as the Sound of one Flute or one Man's Voice. A compound Sound confifts of the Sounds of feveral distinct Voices or Bodies all united in the same individual Time and Measure of Duration, i. e. all striking the Ear together, whatever their other Differences may be. But we must here distinguish a natural

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and artificial Composition; to understand this, remember, That the Air being put into Motion by any Body, communicates that Motion to other Bodies; the natural Composition of Sounds is therefore, that which proceeds from the manifold Reflexions of the First Sound, or that of the Body which first communicates founding Motion to the Air, as the Flute or Violin in one's Hand; these Reflexions, being many, according to the Circumstances of the Place, or the Number, Nature, and Situations of the circumjacent Bodies, make Sounds more or less compound. This is a Thing we know by common Experience; we can have a hundred Proofs of it every Day by finging, or founding any mufical Instrument in different Places, either in the Fields or within Doors; but these Reflexions must be fuch as returning very suddenly don't produce what we call an Eccho, and have only this Effect, to increase the Sound, and make an agreeable Resonance; but still in the same Tune with the original Note; or, if it be a Composition of different Degrees of Tune, they are fuch as mix and unite, fo that the Whole agrees with that Note. But this Composition is not under Rules of Art; for tho' we learn by Experience how to dispose these Circumstances that they may produce the defired Effect, yet we neither know the Number or different Tunes of the Sounds that enter into this Composition; and therefore they come not under the Musician's Direction in what is hereafter called the Composition of Musick; his Care being only about

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bout the artificial Composition, or that Mixture of several Sounds, which being made by Art, are separable and distinguishable one from another. So the distinct Sounds of several Voices or Instruments, or several Notes of the same Instrument, are called simple Sounds, in Distinction from the artificial Composition, in which to answer the End of Musick, the Simples must have such an Agreement in all Relations, but principally and above all in Acuteness and Gravity, that the Ear may receive the Mixture with Pleasure.

VI. THERE remains another Distinction of Sounds necessary to be considered, whereby they are faid to be smooth and evenly, or rough and harsh; also clear or blunt, boarse and obtuse; the Idea's of these Differences must be fought from Observations; as to the Cause of them, they depend upon the Disposition and State of the fonorous Body, or the Circumstances of the Place. Smooth and rough Sounds depend upon the Body principally; We have a notable Example of a rough and harsh Sound in Strings that are unevenly and not of the fame Constitution and Dimension throughout; and for this Reason that their Sounds are very grating, they are called false Strings. I will let you in few Words hear how Monsieur Perrault accounts for this. He affirms that there is no fuch Thing as a simple Sound, and that the Sound of the fame Bell or Chord is a Compound of the Sounds of the feveral Parts of it; so that where the Parts are homogeneous, and the Dimensions or Figure uniform, there is always fuch a perfect Union

and Mixture of all these Sounds that makes one uniform, fmooth and evenly Sound; and the contrary produces Harshness; for the Likeness of Parts and Figure makes an Uniformity of Vibrations, whereby a great Number of fimilar and coincident Motions conspire to fortify and improve each other mutually, and unite for the more effectual Production of the same Effect. He proves his Hypothesis by the Phenomena of a Bell, which differs in Tone according to the Part you strike, and yet strike it any where there is a Motion over all the Parts; he confiders therefore the Bellas composed of an infinite Number of Rings, which according to their different Dimension's have different Tones: as Chords of different Lengths have(cateris paribus) and when it is struck, the Vibrations of the Parts immediately struck specify the Tone, being supported by a sufficient Number of confonant Tones in other Parts: And to confirm this, he relates a very remarkable Thing; He fays, He happen'd in a Place where a Bell founded a Fifth acuter than the Tone it used to give in other Places; which in all Probability, fays he, was owing to the accidental Disposition of the Place, that was furnished with such an Adjustment for reflecting that particular Tone with Force, and so unfit for reflecting others, that it absolutely prevailed and determined the Concord and total Sound to the Tone of that Fifth. If we consider the Sound of a Violin, and all string'd Instruments, we have a plain Demonstration that every Note is the Effect of fevees

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feveral more simple Sounds; for there is not only the Sound refulting from the Motion of the String, but also that of the Motion of the Parts of the Instrument; that this has a very confiderable Effect in the total Sound is certain, because we are very sensible of the tremulous Motion of the Parts of the Violin, and especially because the same String upon different Violins founds very differently, which can be for no other Reason but the different Constitution of the Parts of these Instruments, which being moved by Communication with the String increase the Sound, and make it more or less agreeable, according to their different Natures: But Perrault affirms the fame of every String in it felf without confidering the Instrument; he fays, Every Part of the String has its particular Vibrations different from the gross and fensible Vibrations of the Whole, and these are the Causes of different Motions (and Sounds) in the Particles; which being mix'd and unite, as was faid of the Sounds that compose the total Sound of a Bell, make an uniform and evenly Composition, wherein not only one Tone prevails, but the Misture is smooth and agreeable; but when the Parts are unevenly and irregularly constitute, the Sound is harsh and the String from that called false. And therefore fuch a String, or other Body having the like Fault, has no certain and distinct Tone, being a Composition of several Tones that don't unite and mix fo as to have one Predominant that specifies the total Tone. AGAIN

AGAIN for clear or hoarse Sounds, they depend upon Circumstances that are accidental to the fonorous Body; fo a Man's Voice, or the Sound of an Instrument will be hollow and hoarfe, if it is raifed within an empty Hogshead, which is clear and bright out of it; the Reafon is very plainly the Mixture of other and different Sounds raifed by Reflexion, that corrupt and change the Species of the primitive and direct Sound.

Now that Sounds may be fit for obtaining the End of Musick they ought to be smooth and clear; especially the First, because if they have not one certain and difcernible Tone, capable of being compared to others, and standing to them in a certain Relation of Acuteness, whose Differences the Ear may be able to judge of and measure, they cannot possibly anfwer the End of Mulick, and therefore, are no

Part of the Object of it.

But there are also Sounds which have a certain Tone, yet being excessive either in Aenteness or Gravity, bear not that just Proportion to the Capacity of the Organs of Hearing, as to afford agreeable Sensations. Upon the Whole then we shall call that harmonick or musical Sound, which being clear and evenly is agreeable to the Ear, and gives a certain and discernible Tune (hence also called tunable Sound) which is the Subject of the whole Theory of Harmony.

Thus we have confidered the Properties and Affections of Sound that are any way ne-

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cessary to the Subject in hand; and of all the Things mentioned, the Relation of Acutenels and Gravity, or the Tune of Sounds, is the principal Ingredient in Musick; the Distinctness and Determinateness of which Relation gives found the Denomination of barmonical or mulical: Next to which are the various Measures of Duration. There is nothing in Sounds without these that can make Musick; a just Theory whereof abstracts from all other Things, to confider the Relations of Sounds in the Measures of Tune and Duration; tho' indeed in the Practice other Differences are confidered (of which fomething more may be faid afterwards) but they are fo little, compared to the other Two, and under so very general and uncertain Theory, that I don't find they have ever been brought into the Definition of Mu-Protested are made of the Application of sail

Mean of that Ple fire, they cannot be call of § 2. Containing the Definition and Division of Musick. Wy device and the Contract of The

ger to didne other Parroles was more Planting viterio biguado em sineit en amaitro post mo

Sometice divided by a rheld two coveral Parts That Musick has for its Object, in general, Sound; and particularly, Sounds confidered in their Relations of Tune and Duration, as under that Formality they are capable of affording agreeable Sensations. I shall therefore define Musick, A Science that teaches how Sounds, under certain Measures of Tune and

or disposed, as in Consonance (i. e. joynt founding) or Succession, or both, they may

raise agreeable Sensations.

PLEASURE, I have faid, is the immediate End of Musick; I suppose it therefore as a Principle, That the Objects proposed are capable, being duly applied, to affect the Mind agreeably; nor is it a precarious Principle; Experience proves, and we know by the infallible Testimony of our Senses, that some simple Sounds fucceed others upon the Ear with a positive Pleafure, others difagreeably; according to certain Relations of Tune and Time; and fome compound Sounds are agreeable, others offentive to the Ear; and that there are Degrees and Variety in this Pleasure, according to the various Measures of these Relations. For what Pretences are made of the Application of Mufick to some other Purposes than mere Pleasure or Recreation, as these are obtain'd chiefly by Means of that Pleasure, they cannot be called the immediate End of it.

FROM the Definition given, we have the Science divided into these two general Parts. First, The Knowledge of the MATERIA MUSICA, or, how to produce Sounds, in such relations of Tune and Time as shall be agreeable in Consonance or Succession, or both. I don't mean the actual producing of these Sounds by an Instrument or Voice, which is merely the mechanical or effective Part; But the Knowledge of the various Relations of Tune and Time, which

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me. ich which are the essential Principles out of which the Pleasure sought arises, and upon which it depends. This is the pure speculative Part of Musick. Second, How these Principles are to be applied; or, how Sounds, in the Relations that belong to Musick (as these are determined in the First Part) may be ordered, and variously put together in Succession and Consonance so as to answer the End; which Part we rightly call THE ART of COMPOSITION; and it is

properly the practical Part of Mulick.

Some have added a Third Part, viz. The Knowledge of Instruments; but as this depends altogether upon the First, and is only an Application or Expression of it, it could never be brought regularly into the Definition; and so can be no Part of the Division of the Science; yet may it deserve to be treated of, as a Consequent or Dependent of it, and necessary to be understood for the effective Part. As this has no Share in my Design, I shall detain you but while I fay, in a few Words, what I think fuch a Treatife should contain. And 1 mo, There should be a Theory of Instruments, giving an Account of their Frame and Construction, particularly, how, supposing them completely provided of all their Apparatus, each contains in it the Principles of Musick i. e. how the several Degrees of Tune pertaining to Musick are to be found upon the Instruments. The Second Part should contain the Practice of Instruments, in such Directions as might be helpful for the dextrous and nice handling of them, or the elegant Performance

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of Musick: And here might be annex'd Rules for the right Use of the Voice. But after all, I believe these Things will be more successfully done by a living Instructor, I mean a skilful and experienced Master, with the Use of his Voice or Instrument; tho' I doubt not such might help as too by Rules; but I have done with this.

You must next observe with me, That as the Art of common Writing is altogether diftind from the Sciences to which it is subservient by preferving what would otherwife be loft, and communicating Thoughts at Distance; so there is an Art of Writing proper to Mulick, which teaches how, by a fit and convenient Way of representing all the Degrees and Measures of Sound, fufficient for directing in the executive Part one who understands how to use his Voice or Inftrument: The Artist when he has invented a Composition answering the Principles and End of Musick, may preserve it for his own Use, or communicate it to another present or absent. To this I have very justly given a Place in the following Work, as it is a Thing of a general Concern to Mulick, the' no Part of the Science, and merely a Handmaid to the Practice; and particularly as the Knowledge of it is necessary for carrying on my Delign. I now return to the Division above made, which I shall follow in explaining this Science.

THE First general Branch of this Subject, which is the contemplative Part, divides naturally into these. First, the Knowledge of the Relations and Measures of Tune. And Secondly, of Time.

Time. The First is properly what the Ancients called HARMONICA, or the Doctrine of Harmony in Sounds; because it contains an Explication of the Grounds, with the various Meafures and Degrees of the Agreement (Harmony) of Sounds in respect of their Tune. The other they called Rythmica, because it treats of the Numbers of Sounds or Notes with respect to Time, containing an Explication of the Measures of long and short, or swift and slow

in the Succession of Sounds.

The Second general Branch, which is the PRACTICAL Part, as naturally divides into Two Parts answering to the Parts of the First: That which answers to the Harmonica, the Ancients called Melopaia; because it contains the Rules of making Songs with respect to Tune and Harmony of Sounds; tho' indeed we have no Ground to believe that the Ancients had any Thing like Composition in Parts. That which answers to the Rythmica, they called Rythmopaia, containing the Rules concerning the Application of the Numbers and Time. I shall proceed according to this natural Division, and so the Theory is to be first handled.

C HA P. II.

- Of Tune, or the Relation of Acuteness and Gravity in Sounds; particularly, of the Cause and Measure of the Differences of Tune.
- § 1. Containing some necessary Definitions and Explications, and the particular Method of treating this Branch of the Science concerning Tune or Harmony.

IRST, The Subject to be here explained is, That Property of Sounds which I have called their Tune; whereby they come under the Relation of acute and grave to one another: For as I have already observed, there is no fuch Thing as Acuteness and Gravity in an absolute Sense, these being only the Names given to the Terms of the Relation; but when we consider the Ground of the Relation which is the Tune of the Sound, we may justly affirm this to be fome thing absolute; every Sound having its own proper and peculiar Tune, which must be under some determinate Measure in the Nature of the Thing, (but the Denominations of acute and grave refpect always another Sound.) Therefore as to Tune, we must remark that the only Difference can possibly be betwixt one Tune and another, f

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is in their Degrees, which are naturally infinite; that is, we conceive there is fomething positive in the Cause of Sound which is capable of less. and more, and contains in it the Measure ofthe Degrees of Tune; and because we don't suppose a least or greatest Quantity of this, therefore we fay the Degrees depending on these Measures are infinite: But commonly when we speak of these Degrees, we call them feveral Degrees of Acuteness and Gravity, without supposing these Terms to express any fixt and determinate Thing; but it implies some supposed Degree of Tune, as a Term to which we tacitely compare feveral other Degrees; thus we suppose any one given or determinate Meafure of Tune, then we suppose a Sound to move on either Side, and acquire on the one greater Measures of Tune, and on the other lesser, i. e. on the one Side to become gradually more acute, and on the other more grave than the given Tune, and this in infinitum: Why I ascribe the greater Measure to Acuteness will appear, when we see upon what that Measure depends. Now tho' these Degrees are infinite, yet with respect to us they are limited, and we take fome middle Degree, within the ordinary Compass of the human Voice, which we make the Term of Comparison when we lay of a Sound that it is very acute or very grave, or, as we commonly fpeak, very high or very low.

II. IF Two or more Sounds are compared > in the Relation we now treat of, they are either

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ther equal or unequal in the Degree of Tune: Such as are equal are called Unifons with regard to each other, as having one Tune; the unequal, being at Distance one from another (as I have already explain'd that Word) constitute what we call an Interval in Musick, which is properly the Difference of Tune betwixt Two Sounds. Upon this Equality or Difference does the whole Effect depend; and in respect of this we have these Relations again divided into,

the Denomination of all these Relations that are always and of themselves agreeable, whether applied in Succession or Consonance (by which Word I always mean a mere sounding together;) that is, If two simple Sounds are in such a Relation, or have such a Difference of Tune, that being sounded together they make a Mixture or compound Sound which the Earreceives with Pleasure, that is called Concord; and whatever Two Sounds make an agreeable Compound, they will always follow other agreeably. Discord is the Denomination of all the Relations or Differences of Tune that have a contrary Effect.

IV. Concords are the effential Principles of Musick; but their particular Distinctions, Degrees and Names, we must expect in another Place. Discords have a more general and very remarkable Distinction, which is proper to be explained here; they are either concinnous or inconcinnous Intervals; the concinnous are such as are apt or fit for Musick, next to and

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in Combination with Concords; and are neither very agreeable nor very difagreeable in themselves; they are fuch Relations as have a good Effect in Musick only as, by their Opposition, they heighten and illustrate the more essential Principles of the Pleafure we feek for; or by their Mixture and Combination with them, they produce a Variety necessary to our being better pleased; and therefore are still called Discord, as the Bitterness of some Things may help to let off the Sweetness of others, and yet still be bitter: And therefore in the Definition of Concord I have faid always and of themselves agreeable, because the concinnous could have no good Effect without these, which might subsist without the other, tho' less perfectly. The other Degrees of Discord that are never chosen in Musick come under the Name of inconcinnous and have a greater Harshness in them, tho' even he greatest Discord is not without its Use. Again the concinnous come under a Distinction with respect to their Use, some of them being admitted only in Succession, and others only in Consonance; but enough of this here.

V. Now to apply the Second and Third Article observe, Unisons cannot possibly have any Variety, for there must be Difference where there is Variety, therefore Unisonance slowing from a Relation of Equality which is invariable, there can be no Species or Distinction in it; all Unisons are Concord, and in the First and most perfect Degree; but an Interval depending upon a Difference of Tune or a Re-

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lation of Inequality; admits of Variety, and so the Terms of every Interval, according to the particular Relation or Difference, make either Concord or Discord. Some indeed have restrained the Word Concord to Intervals, making it include a Difference of Tune; but it is precarious; for as the Word Concord signifies an Agreement of Sounds, 'tis certainly applicable to Unisons in the First Degree.

OBSERVE, the Words Concord and Harmony are of the same Sense; yet they are arbitrarily made different Terms of Art; Concord signifies the agreeable Effect of two Sounds in Consonance; Harmony is applied to the Agreement of any greater Number of Sounds in Consonance. Again Harmony always signifies Consonance, but Concord is applied sometimes also to Succession, yet never but when the Terms can stand agreeably in Consonance: The Effect of an agreeable Succession of several Sounds being particularly called Melody.

VI. INTERVALS differ in Magnitude; and in this there is an infinite Variety, according to the possible Degrees of Tune; for there is no Difference so great or little but a greater or less is further imaginable: But if we consider it with regard to what's practicable, there are Limits, which are the least and greatest Intervals our Ears are Judges of, and can be actually produced by Voice or Instruments; besides which there is yet a further Limitation from what's uleful for attaining the Ends of Musick.

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VII. INTERVALS are distinguished into 9 simple and compound; a simple Interval is without Parts or Division; a compound consists of feveral lesser Intervals. Now 'tis plain this Distinction has a Regard to Practice only, because there is no such Thing as a least Interval: Besides, by a simple Interval is not meant here the least practifed, but such as, tho' it were equal to Two or more lesser which are in Use, yet, when we would make a Sound move fo far up or down, we always pass immediately from its one Term to the other; what is meant then by a compound Interval will be very plain, it is fuch whose Terms are, in Practice, taken either in immediate Succession, or we make the Sound to rife and fall from the one to the other by touching fome intermediate Degrees, fo that the Whole is a Composition of all the Intervals from one Extreme to the other. What I call a simple Interval the Ancients called a Diastem; and they called the compound a System: Each of these has Differences; even of the fimple there are some greater and lesser, and they are always Discord; but of the compound or System, some are Concord, some Discord. But again,

VIII. SYSTEMS of the same Magnitude (and consequently of the same Degree of Concord and Discord) may differ in respect of their Composition, as containing and being actually divided into more or sewer Intervals. And when that Number is equal, yet the Parts may differ in Magnitude. Lastly, when they consist of the very

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same Parts or lesser Intervals, there may be a Difference of the Order and Position of them

betwixt the Extremes.

IX. A most remarkable Distinction of Systems is into concinnous and inconcinnous. these Words are applied to simple Intervals we have already feen; but to Systems they are applied in a twofold Manner, thus, In every System that is concinnously divided, the Parts considered as simple Intervals must be concinnous in the Sense of Article Third; but not only fo, they must be placed in a certain Order betwixt the Extremes, that the Succession of Sounds from one Extreme to the other, may be agreeable, and have a good Effect in Practice. inconcinnous System therefore is that where the simple Intervals are inconcinnous, or ill dispofed betwixt the Extremes.

X. A System is either particular, or univer-sal, containing within it every particular System that belongs to Musick, and is called, The Scale of Musick, which may be defined, A Series of Sounds rifing or falling towards Acuteness or GRAVITY from any given Sound, to the greatest Distance that is fit and practicable, thro' fuch intermediate Degrees, as make the Succession most agreeable and perfect, and in which we have all the concording In-

tervals most concinnously divided.

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THE right Composition of such a System is of the greatest Importance in Musick, because It will contain the whole Principles; and fo the Task

Task of this Part may be concluded in this, viz. To explain the Nature, Constitution and Office of the Scale of Musick; for in doing this, the whole fundamental Grounds and Principles of Musick will be explain'd; which Ishall go through in this Order, 1mo. I shall explain upon what the Tune of a Sound depends or at least fomething which is inseparably connected with it; and how from this the relative Degrees of Tune, or the Intervals and Differences are determined and measured. 2do. I shall consider the Nature of Concord and Discord, to explain, or at least show you what has been or may be faid to explain the Grounds of their different Effects. 3 tio and 4to. I shall more partiticularly confider the Variety of Concords, with all their mutual Relations: In order to which I shall deliver as succinctly as I can the harmonical Arithmetick. teaching how musical Intervals are compounded and refolved, in order particularly to find their Differences and mutual Relations, Connections with, and Dependencies one on another. 5to. I shall explain what may be called The geometrical Part of the Theory, or, how to express the Degrees and Intervals of harmonick Sound by the Sections and Divisions of right Lines. 6to. I shall explain the Composition and Degrees of Harmony as that Term is already distinguished from Concord. 7mo. I shall. consider the concinnous Discords that belong to Musick; and explain their Number and Use; how with the Contords they make up the universal System, or constitute what we call The Scale

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he sk Scale of Musick, whose Nature and Office I shall very particularly explain; wherein there will be several Things handled that are fundamental to the right understanding of the practical Part; particularly, 8vo. The Nature of Modes and Keys in Musick (see the Words explain'd in their proper Place) And gno. The Consequences with respect to Practice, that follow from having a Scale of fix'd and determinate Sounds upon Instruments; and how the Desects arising from this are corrected.

§ 2. Of the Cause and Measure of Tune; or upon what the Tune of a Sound depends; and how the relative Degrees or Differences of Tune are determined and measured.

IT was first found by Experience, That many Sounds differing in Tune, the the Measures of the Differences were not yet known, raised agreeable Sensations, when applied either in Consonance or Succession; and that there were Degrees in this Pleasure. But while the Measures of these Differences were not known, the Ear must have been the only Director; which the the infallible Judge of what's agreeable to its felf; yet perhaps not the best Provisor: Reason is a superior Faculty, and can make the of former Experiences of Pleasure to contrive and invent new ones; for, by examining the Grounds and Causes of Pleasure in one Instance,

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stance, we may conclude with great Probability, what Pleasure will arise from other Caufes that have a Relation and Likeness to the former; and tho' we may be mistaken, yet it is plain, that Reason, by making all the probable Conclusions it can, to be again examined by the Judgment of Senfe, will more readily discover the agreeable and disagreeable, than if we were left to make Experiments at Random, without observing any Order or Connection, i. e. to find Things by Chance. And particularly in the present Case, by discovering the Cause of the Difference of Tune, or something at least that is inseparably connected with it, we have found a certain Way of measuring all their relative Degrees; of making distinct Comparisons of the Intervals of Sound; and in a Word, we have by this Means found a perfect Art of raising the Pleasure, of which this Relation of Sounds is capable, founded on a rational and well ordered Theory, which Sense and Experience confirms. For unless we could fix these Degrees of Tune, i. e. meafure them, or rather their Relations, by cortain and determinate Quantities, they could never be exprest upon Instruments: If the Ear were fufficient for this as to Concords, I may fay, at least, that we should never otherwise have had fo perfect an Art as we now have; because, as I hope to make it appear, the Improvement is owing to the Knowledge of the Numbers that express these Relations: Without which, again, how could we know what Progress were made in discovering the Relations of Tune capable to please; for in all Probability it was with this, as much more of our Knowledge, the first Discovery was by Accident, without any deliberate Enquiry, which Men could never think of till something accidental as to them made a First Discovery; nor could we at this Day be reasonably sure that some such Accident shall not discover to us a new Concord, unless we satisfied our selves by what we know of the Cause of Acuteness and Gravity, and the mutual Relations of concording Intervals, which I am now to explain.

ACCORDING to the Method I have proposed in this Essay, you must expect in another Place, an Account of the First Enquirers into the Measures of Acuteness and Gravity; and here I go on to explain it as our own Experience and Rea-

fon confirms to us.

This Affection of Sounds depends, as I have already faid, altogether upon the sonorous Body; which differs in Tune. 1mo. According to the specifick Differences of the Matter; thus the Sound of a Piece of Gold is much graver than that of a Piece of Silver of the same Shape and Dimensions; and in this Case the Tones are proportional to the specifick Gravities, (cateris paribus) i. e. the Weights of Two Pieces of the same Shape and Dimension. Or, 2do. According to the different Quantities of the same specifick Matter in Bodies of the same Figure; thus a solid Sphere of Brassone Foot Daimeter will sound acuter than one of the same Brass Two Foot

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Foot Diameter; and here the Tones are proportional to the Quantities of Matter, or the

absolute Weights.

But neither of these Experiments can reafonably fatisfy the prefent Enquiry. There appears indeed no Reason to doubt that the same Ratio's of Weights (cateris paribus) will always produce Sounds with the fame Difference of Tone, i. e. constitute the same Interval; yet we don't fee in these Experiments, the immediate Ground or Caufe of the Differences of Tone; for tho' we find them connected with the Weights, yet it is far from being obvious how these influence the other; so that we cannot refer the Degrees of Tone to these Quantities as the immediate Cause; for which Reafon we should never find, in this Method of determining these Degrees, any Explication of the Grounds of Concord and Harmony; which can only be found in the Relations of the Motions that are the Cause of Sound; in these Motions therefore must we feek the true Measures of Tune; and this we shall find in the Vibrations of Chords: For tho' we know that the Sound is owing to the vibratory Motion of the Parts of any Body, yet the Measures of these Motions are tolerably plain, only in the Cafe of Chords.

It has been already explained; that Sounds are produced in Chords by their vibratory Motions; and tho according to what has been explained in the preceeding *Chapter*, these sensible Vibrations of the whole Chord are not the immedi-

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Foot Diameter; and here the Tones are proportional to the Quantities of Matter, or the

absolute Weights.

But neither of these Experiments can reafonably fatisfy the present Enquiry. There appears indeed no Reason to doubt that the same Ratio's of Weights (ceteris paribus) will always produce Sounds with the fame Difference of Tone, i. e. constitute the same Interval; yet we don't fee in these Experiments, the immediate Ground or Caufe of the Differences of Tone; for tho' we find them connected with the Weights, yet it is far from being obvious how these influence the other; so that we cannot refer the Degrees of Tone to these Quantities as the immediate Cause; for which Reafon we should never find, in this Method of determining these Degrees, any Explication of the Grounds of Concord and Harmony; which can only be found in the Relations of the Motions that are the Cause of Sound; in these Motions therefore must we seek the true Measures of Tune; and this we shall find in the Vibrations of Chords: For tho' we know that the Sound is owing to the vibratory Motion of the Parts of any Body, yet the Measures of these Motions are tolerably plain, only in the Cafe of Chords.

It has been already explained; that Sounds are produced in Chords by their vibratory Motions; and tho according to what has been explained in the preceding *Chapter*, these sensible Vibrations of the whole Chord are not the immedi-

ate Cause of the Sound, yet they influence these infensible Motions that immediately produce it; and, for any Reason we have to doubt of it, are always proportional to them; and therefore we may measure Sounds as justly in these, as we could do in the other if they fell under our Measures: But even these sensible Vibrations of the whole Chord cannot be immediately measured, they are too small and quick for that; and therefore we must seek another Way of measuring them, by finding what Proportion they have with some other Thing: And this can be done by the different Tenfions, or Groffness, or Lengths of Chords that are in all other respects, except any one of these mentioned, equal and alike; the Chords in all Cases being supposed evenly and of equal Dimensions throughout : And of all Kind of Chords Metal or Wirestrings are best to make the following Experiments with.

Now, in general, we know by Experience that in two Chords, all Things being equal and alike except the Tension or the Thickness or the Length; the Tones are different; there must therefore be a Difference in the Vibrations, owing to these different Tensions, ocwhich Difference can only be in the Velocity of the Courses and Recourses of the Chords, thro' the Spaces in which they move to and again beyond the ftraight Line: We are therefore to examine the Proportion between that Velocity and the Things mentioned on which it depends. And mind that to prevent faying fo oft cateris paribus e

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bus, you are always to suppose it when I speak of Two Chords of different Tenfions, Lengths, or

Groffness.

PROPOSITION I. If the elastick Chord AB. (Plate 1. Fig. 1.) be drawn by any Point o, in he Direction of the Line o D, every Vibration it makes will be in a leffer Space as od, till it be at perfect Rest in its natural Position AoB; and the elastick or restituent Force at each Point d of the Line oD (i. e. at the Beginning of each Vibration) will be in a simple direct

Proportion of the Lines oD, od, od.

DEMONSTRATION. That the Vibrations become gradually less till the Chord be at Reft. is plain; and that this must proceed from the Decrease of the elastick Force is as plain; lastly that this Force decreases in the Proportion mentioned, is proven by this Experiment made upon a Wire-string, viz. that being stretched lengthwife by any Weight, if feveral Weights are applied successively to the Point o, drawing the Chord in the same Direction as ob. they bend it so that the Distances of od to which the feveral Weights draw it, are in simple direct Proportion of these Weights: But Action and Reaction are equal and contracy, therefore the Resistance which the Chord by its Elasticity makes to the Weight, is equal to the Gravity or drawing Force of that Weight, i. e. the restituent Forces in the Points D, d, areas the Lines o D, o d; now it is the fame Case whether the Chord be stretcht by Weight or any other Force; for when we suppose it **ftretcht**

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fretcht to D, or d, the elastick Force is the same Thing, and in the same Proportion at these Points, whatever the bending Force is; there-

fore the Proposition is true.

COROLLARY. The Vibrations of the same Chord are all performed in equal Time; because in the Beginning of each Vibration, the restituent or moving Force, is as the Space to be gone thro'; for it is as the half Space oD, but Halfs are as the Wholes.

SCHOLIUM. In the preceeding Experiment (which is Dr. Gravefande's) the Vibrations are taken very small, that is, at the greatest bending the Line o D is not above a Quarter of an Inch, the Chord being Two Foot and a Half long. And if the Proposition be but physically true with respect to the very small Vibrations, it will sufficiently answer our Purpose, for indeed Chords while they sound vibrate in

very fmall Spaces.

But again, as to the Corollary, which is the principal Thing we have use for, it will perhaps be objected, that I have only considered the Motion of the Point o or D, without proving that the elastick Force in the rest of the Points are also proportional to the Distances; but as the whole bending Force is immediately applied to one Point, (tho' thereby it acts upon them all) the restitutive Force may be referred all to the same Point; or, we may consider the whole Area ABD, which is the Effect of the bending, as the Space to be run thro' by the whole Body or Chord ABD, and these Areas are as the Lines

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Lines o D, o d, viz. The Altitudes of different Figures having the same common Base AB, and a similar Curve ADB, and AdB; for strictly speaking the Chord is a Curve in its Vibrations; and if we take AD, and DB for straight Lines, as they are very nearly, and without any sensible Variation in such small Vibrations as we now suppose, then it will be more plain that these Areas are as the Lines o D, o d; and because in this Way we consider the Action upon, and Reaction of all the Points of the Chord, therefore the Objection is removed.

But there remains one Thing more, viz. That the Conclusion is drawn from the Forces or Velocities in the several Points D, d, as if they were uniform thro' all the Space; whereas in the Nature of the Thing they are accelerated from D to o, and in the same Proportion retarded on the other Side of o: The Answer to this is plainly, that since the Acceleration is of the same Nature in all the Vibrations, it must be the same Case with respect to the Time as if the Motion were uniform.

Now from the Confideration of this Acceleration, there is another Demonstration drawn of the preceding Corollary; and that I may show it, let me first prove that there must be an Acceleration, and then explain the Nature of it. First. Suppose any one Vibration from D to 0, in that the Point D must move into d, d, successively, before it come to 0; and if there were no Acceleration, but that the Point D, in

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every Polition of the Chord, as A d B, had no more elastick Force than is equal to a Force that could keep it in that Position; 'tis plain it could never pass the Point o; because these Forces are as the Distances, and therefore it is nothing in the Point o; but it actually passes that Point, and consequently the Motion is accelerated; and the Law of the Acceleration is this, In every Point of the same Vibration, the Point D is accelerated by a Force equal to what would be fufficient to retain it in that Polition; but these Points being as the Distances od, od, the Motion of the Point D agrees with that of a Body moving in a Cycloid, whose Vibrations the Mathematicians demonstrate to be of equal Duration (vid. Keil's Introductio adveram physicam) and therefore the Times of the Vibrations of the Chord are also equal (vid. GRAVES ANDE'S mathematical Elements of Physicks. Book I. Chap. 26.)

BEFORE we proceed farther, I shall apply this Proposition to a very remarkable Phanomenon; that Experience and our Reasonings may mutually support one another. It is a very obvious Remark, That the Sound of any Body arising from one individual Stroke, tho' it grows gradually weaker, yet continues in the same Tone: We shall be more sensible of this by making the Experiment on Bodies that have a great Resonance, as the larger Kind of Bells

and long Wire-strings.

Now fince the *Tone* of a Sound depends upon the Nature of these Vibrations, whose Dif-

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Differences we can conceive no otherwise than as having different Velocities; and fince we have proven that the fmall Vibrations of the fame Chord are all performed in equal Time; lastly, since it is true in Fact that the Tone of a Sound which continues for some Time after the Stroke, is from first to last the same; it follows, I think, that the Tone is necessarily connected with a certain Quantity of Time in making every fingle Vibration; or, that a cerain Number of Vibrations, accomplished in a given Time, constitutes a certain and determihate Tone; for this being supposed we have a good Reason of that Phenomenon of the Unity of Tone mentioned: And this mutually confirms he Truth of the Proposition, that the Vibrations are all made in equal Time; for this Unity of Tone supposes an Unity in that on which he Tone depends, or with which our Pereption of it is connected; and this cannot be upposed any other Thing than the Equality of he Vibrations, in the Time of their Courfes nd Recourfes: For the absolute Velocity, or lastick Force, in the Beginning of each Vibraion is unequal, being proportional to the Power that could retain it in that Pofition.

AGAIN, if we could absolutely determine now many Vibrations any Chord, of a given Length, Thickness and Tension, makes in a given Time, this we might call a fix'd Sound or rather a fix'd Tone, to which all others might e compared, and their Numbers be also deter-

mined; but this is a mere Curiosity, which neither promotes the Knowledge or Practice of Musick; it being enough to determine and measure the *Intervals* in the Proportions and relative Degrees of *Tone*, as in the follow-

ing Propositions.

PROPOSITION II. Let there be Two elastick Chords A and C (Plate 1. Fig. 2.) differing only in Tension, i. e. Let them be stretcht Length-wise by different Weights which are the Measures of the Tension; the Time of a Vibration in the one is to that of the other inversely as the square Root of the Tensions of Weights that stretch them. For Example, if the Weights are as 4: 9. the Times are

as 3:4. DEMONSTRATION. If Two Chords C and A (Plate 1. Fig. 2.) differ only in Tension, they will be bended to the fame Distance O D by Weights (fimilarly applied to the Points o) which are directly proportional to their Ten fions; this is found by Experiment (vid. Gravefande's Elements.) Again, these Two Chord bended equally, may be compared to Two Pendulums vibrating in the fame or like Cycloid with different accelerating Forces; in which Cafe the Mathematicians know, it is demonstrated that the Times are inverfely as the square Root of the Tensions, which are as the accelerating i. e. the bending Forces, when they are draw to equal Distances; but the Proposition is true whether the Distances O D be equal or not

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because all the Vibrations of the same Chord

are of equal Duration by Prop. 1.

COROLLARY. The Numbers of the Vibrations accomplished in the same Time are directly as the square Roots of their Tensions. For Example, If the Tensions are as 9 to 4. the Numbers of Vibrations in the same Time will be as 3 to 2.

PROPOSITION III. The Numbers of Vibrations made in the same Time by Two Chords, A and B (Plate 1. Fig. 3.) that differ only in Thickness, are inversely as the square Roots of the Weights of the Chords, i. e. as the Diameter

of their Bases inversely.

DEMONSTRATION. We know by common Experience that the thicker and groffer any Chord is, being bended by the same Weight, it gives the more grave Sound; so that the Tone is as the Thickness in general: But for the particular Proportion, we have this Experiment, viz. Take Two Chords B and C (Plate 1. Fig. 3.) differing only in Thickness; let the Weights they are stretched with be as the Weights of the Chords themselves, i. e. as the Squares of their Diameters; their Sounds are unifon, therefore the Number of Vibrations in each will be equal in the fame Time: And confequently if the thick Chord B. be compared to another of equal Length A(in the same Figure) stretched with the same Weight, but whose Thickness is only equal to that of the smaller Chord C last compared to it; the Numbers of Vibrations of B and A will be

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as the square Roots of the Weights of the Chords inversely: That is, inversely as the Diameters of their Bases, or the Bores thro' which the Wire is drawn.

PROPOSITION IV. If Two Chords A and B, in Plate 1. Fig. 2. differ only in their Lengths, the Time of a Vibration of the one is to that of the other as the Lengths directly; and consequently as the Number of Vibrations in the same Time inversely. For Example, Let the one be Three Foot and the other Two, the First will make Two Vibrations and the other Three

in the same Time.

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X

DEMON. 'Tis Matter of common Observation, that if you take any Number of Chords differing only in Length, their Sounds will be gradually acuter as the Chords are sworter; and for the Proportion of the Lengths and Vibrations, it will be plain from what has been already faid; for the same Tone is constitute by the same Number of Vibrations in a given Time; and we know by Experience that if Two Chords C and B (Plate 1. Fig. 2.) differing only in Length, are tended by Weights which are as the Squares of their Lengths, their Sounds are unison; therefore they make an equal Number of Vibrations in the fame Time. But again, by Proposition 2. the N mber of Vibrations of the longest of these Two Chords C, is to the Number in the Same Time, of an equal and like Chord A (in the same Figure) less tended, as the square Roots of the Tensions directly; therefore if

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A is tended equally with the shorter Chord B (whose Vibrations are equal to those of the longer Chord D that's most tended)'tis plain the Number of Vibrations of these two must be as their Lengths, because these Lengths are directly as the square Roots of the unequal Tensions.

OBSERVE, that if we suppose this Proportion of the Time and Lengths to be otherwise demonstrated, then what is here advanced as an Experiment will follow as a Consequence from this Proposition and the Second. But I think this Way of demonstrating the Proposition very plain and satisfying. You may also see from what Considerations Dr. Gravesande concludes it. Or we may prove it independently of the Second Proposition, after the Manner of the First by the following

EXPERIMENT. Viz. If the same or equal Weight is similarly applied to similar Points O o, of Two elastick Chords A and B (Plate 1. Fig. 2.) that differ only in Lengths; the Points O, o will be drawn to the Distances O D, o d, that shall be as the Lengths of the Chords A, B; so that the Figures shall be similar, and the whole Areas proportional to the Lengths of the

Chords.

Now the bending Forces in D and d are equal and equally applied, therefore the refittuent Forces are equal; the Times confequently are as the Spaces, i. e. as the Areas or the Chords A, B, and this holds whatever the Difference of o d and O D is, fince all the Vibrations

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CHAP. II.

Time; and therefore, lastly, the Numbers of Vibrations in a given Time are as these Lengths inversely.

OBSERVE. From this Demonstration and the Experimentused in the former Demonstration, we see the Truth of *Proposition* 2. in another than the proposition 2.

her View.

GENERAL Corollary to the preceeding Propositions. The Numbers of Vibrations made in the same Time by any Two Chords of the same Matter, differing in Length, Thickness and Tension, are in the compound Ratio of the Diameters and Lengths inversely, and the square

Roots of the Tensions directly.

Now let us fum up and apply what has been explained, and, first, We have concluded that the Differences of Tone or the Intervals of harmonick Sound are necessarily connected with the Velocity of the Vibrations in their Courses and Recourses, i.e. the Number of Vibrations made in equal Time by the Parts of the for norous Body: And because these Numbers cannot be measured in themselves immediately, we have found how to do it in Chords, by the Proportions betwixt them and the different Tensions or Thickness or Lengths; we have not fought any absolute and determinate Number of Vibrations in any Chord, but only the Ratio or Proportion betwixt the Numbers accomplished in the same Time, by several Chords differing in Tension or Thickness or Length, or in all these; therefore we have discovered the true

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true and just Measures of the relative Degrees of Tone, not only in Chords, but in all other Bodies; for if it is reasonable to conclude, from the Likeness of Causes and Effects, that the fame Tane is constitute in every Body, by the same Number of Vibrations in the same Time, it follows, that whatever Numbers express the Ratio of any Two Degrees in one kind of Body, they express the Ratio of these Two Degrees univerfally; But this would hold without that Supposition, because we can find Two Chords, whose Tones shall be unison respectively to any other Two Sounds; and therefore all the Conclusions we can make from the various Compositions and Divisions of these Ratio's will be true of all Sounds, whatever Differences there be in the Cause.

Numbers to the different Tones of Sound, whereby we express the Relations of one Degree to another, the grave is to the acute as the lesser Number to the greater, because the graver depends upon the least Number of Vibrations; But if we apply these Numbers to the Times of the Vibrations, then, the grave is represented by the greater Number, and the acute by the lesser.

IF we express the same Tones by the Quantity of the different Tensions of Chords that are otherwise equal and like, then the Ratio will be different, because the Tensions are as the Squares of the Vibrations, and the grave will be to the acute as the lesser to the greater: But the Reason why we ought not to use these

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Numbers is, that the' different Tenfions make different Tones, yet we can only examine the Grounds of Concord and Discord, in the Ratio's of the Vibrations, which are immediately the Cause of Sound; and this is a more accurate Way, because these represent something that's common in all Sounds; and besides, being always leffer Numbers (viz. the square Roots of the other) are more convenient for the eafy Comparison of Intervals. As to the Diameters or Lengths of different Chords, because they are in a simple Proportion of the Numbers of Vibrations, therefore the fame Numbers reprefent either them or the Vibrations, but inversely; fo that the graver Tone is represented by the longer or grosser Chord: And because Experiments are more easily made with Chords differing only in Lengths; and also because these Proportions are more eafily conceived, and more fenfibly reprefented by right Lines; therefore we also represent the Degrees of Tone by these Lengths, tho' in examining the Grounds of Concord we must consider the Vibrations, which are exprest by the same Num-

THIS brings to Mind a Question which Vincenzo Galilei makes in his Dialogues upon Mufick; he asks, Whether the expressing of the Interval which we call an Octave by the Ratio of 1:2, be reasonably grounded upon this, That if a Chord is divided into Two equal Parts, the Tone of the Half is an Octave to that of the Whole? The Reasons of his Doubt he proposes thus,

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thus, fays he, There are Three Ways we can make the Sound of a Chord acuter, viz. by shortning it, by a greater Tension, and by making it smaller, ceteris paribus. By shortning it the Ratio of an Octave is 1:2. By Tension it is 1:4. and by lessening the Thickness it is also 1: 4. He means in the last Case, when the Tones are measured by the Weights of the Chord. Now he would know why it is not as well 1: 4. as 1: 2. which is the ordinary Expression: I think this Difficulty we have fufficiently answered above; for these Weights are not the immediate Cause of the Sound; it is true we may say that the acute Term of the Octave is to the grave as 4. to 1. meaning only that the acute is produced by Four Times the Weight which determines the other; and if Intervals are compared together by Ratio's taken this Way, we can compound and refolve them, and find their mutual Connections and Relations of Quantity, as truly as by the other Expressions; but the Operations are not fo eafy, because they are greater Numbers: And then, if the Sounds are produced any other Way than by Chords of different Tensions or Thickness, the Tones are to one another as these Numbers in a very remote Sense; for they express nothing in the Cause of these Sounds themselves, but only tell us, that Two Chords being made unifons to these Sounds, their Tensions or Thickness are as these Numbers: But, all Sounds being produced by Motion, when we express the Tones by the Numbers of Vibrations in the same Time, we represent something

that's proper to every Sound; this therefore is the only Thing that can be considered in examining the Grounds of Concord and Discord: And because the same Numbers express the Vibrations and Lengths of Chords, we apply them sometimes also to these Lengths, for Reasons already said.

WE have also gained this further Definition of Acuteness and Gravity, viz. That Acuteness is a relative Property of Sound, which with respect to some other is the Effect of a greater Number of Vibrations accomplished in the same Time, or of Vibrations of a shorter Duration; and Gravity is the Effect of a lesser Number of Vibrations, or of Vibrations of a shorter Duration. And by confidering that the Vibrations proceeding from one individual Stroke are gradually in leffer Spaces till the Motion cease, and that the Sound is always louder in the Beginning, and gradually weaker, therefore we may define Loudness the Effect of a greater absolute Velocity of Motion or a greater Vibration made in the same Time; and Lowness is the Effect of a leffer.

BEFORE I end this Chapter, let us consider a Conclusion which Kircher makes, in his Musurgia universalis. Having proven in his own Way, the Equidiumity of the Vibrations of the same Chord, he draws this Conclusion, That the Sound of a Chord grows gradually more grave as it ceases (tho he owns the Difference is not sensible) because the absolute Velocity of Motion becomes less, i. e. That Velocity where-

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by the Chord makes a Vibration of a certain Space in a certain Time. By this Argument he makes the Degrees and Differences of Tune proportional to the absolute Velocity: But if this is a good Hypothesis, I think it will follow, contrary to Experience, that two Chords of unequal Length (cateris paribus) must give an equal Tune; for to demonstrate the reciprocal Proportion of the Lengths and the Number of Vibrations, he supposes the Tension or elastick Force, which is the immediate Cause of the absolute Velocity, to be equal when the Chords are drawn out to proportional Distance; for by this Equality shorter Chord finishes its Vibrations shorter Time, in Proportion as the Spaces are lester, which are as the Lengths. Again, the Elasticity of the Chord diminishes gradually, fo that in any affignable Time there is at least an indefinite Number of Degrees; and fince the Elasticity has such a gradual Decrease, it seems odd that the Differences of Tune, if they have a Dependence on the absolute Velocity, should not be sensible. But in the other Hypothesis, where I suppose the Degrees of Tune are connected with and proportional to the Duration of a single Vibration, and confequently to the Number of Vibrations in a given Time, there can no abfurd Consequence follow. I am indeed aware of a Difficulty that may be flarted, which is this, That the Duration of a fingle Vibration is a Thing the Mind has nothing whereby to judge of,

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of, whereas it can easily judge of the Difference of absolute Velocity by the different Percussions upon the Ear; and the Defenders of this Hypothesis may further alledge, that the Vibrations that produce Sound are the finall and almost infensible Vibrations of the Body; fo far infensible at least that we can only discern a Tremor, but no distinct Vibrations; and we cannot, fay they, be furprized if the Differences of Tune are insensible. But I suppose the Degrees of Tune of the first Vibrations are predominant, and determine the particular Tune of the Sound; and then it is no less unaccountable how Two Chords drawn out to fimilar Figures, as in Prop. 4. should not give the same Tune, and indeed it feems impossible to be otherwise in this Hypothesis, which yet is contrary to Experience, and for the Difficulty proposed in the other Hypothesis it is at least but a Difficulty and no Contradiction, especially if we suppose it depends immediately on a certain Number of Vibrations in a given Time, which is the Consequence of a shorter Duration of every single Vibration; and this again, I own, supposes there can be no Sound heard till a certain Number of Vibrations are accomplished, the contrary whereof I believe will be difficult to prove. I shall therefore leave it to the Philosophers, because I think the chief Demand of this particular Part is fufficiently answered, which was to know how to take the just Measures of the relative Degrees of Tune, and their Intervals or Differences. You'll remember too, what Reason I have already

already alledged for expressing the Degrees of Tune by the Numbers of Vibrations accomplished in the same Time; for whether the Cause of our perceiving a different Tone lies here or not, the only Way we have of accounting for the Concord and Discord of different Tones, is the Consideration of these Proportions, and whatever may be required in a more univerfal Enquiry into the Nature and Phanomena of Sound, this will be fufficient to fuch Theory, as by the Help of Experience and Observation, may guide us to the true Knowledge of the Science of Musick.

BESIDES, in this Account of the Cause of the Differences of Tune, I follow the Opinion not only of the Ancients but of our more modern Philosophers; Dr. Holder's whole Theory of the natural Grounds and Principles of Harmony, is founded on this Supposition; take his own Words, Chap. 2. " The First and great " Principle upon which the Nature of harmo-

" nical Sounds is to be found out and disco-" vered is this: That the Tune of a Note (to speak " in our vulgar Phrase) is constituted by the

" Measure and Proportion of Vibrations of the " fonorous Body; I mean, of the Velocity of

" these Vibrations in their Recourses, for the " frequenter these Vibrations are, the more a-" cute is the Tune; the flower and fewer they

" are in the same Space of Time, by so much " the more grave is the Tune. So that any

" given Note of a Tune is made by one cer-" tain Measure of Velocity of Vibrations, viz.

"fuch

fuch a certain Number of Courses and Recourses, e. g. of a Chord or String in such a certain Space of Time, doth constitute such

" a determinate Tune.

DOCTOR Wallis in the Appendix to his Edition of Ptolomey's Books of Harmony, owns this to be a very reasonable Supposition; yet he fays he would not politively affirm, that the Degrees of Acuteness answer the Number of Vibrations as their only true Caufe, becaufe he doubted whether it had been fufficiently confirm'd by Experience. Now that Sound depends upon the Vibrations of Bodies, I think, needs no further Proof than what we have; but whether the different Numbers of Vibrations in a given Time, is the true Cause, on the Part of the Object, of our perceiving a Difference of Tune, is a Thing I don't conceive how we can prove by Experiments; and to the present Purpose 'tis enough that it is a reasonable Hypothesis; and let this be the only true Cause or not, we find by Experience and Reason both, that the Differences of Tune are inseparably connected with the Number of Vibrations; and therefore these, or the Lengths of Chords to which they are proportional, may be taken for the true Measure of different Tunes. The Doctor owns that the Degrees of Acutenel's are reciprocally as the Lengths of Chords, and thinks it fufficiently plain from Experience; fince we find that the shorter Chord (cateris paribus) gives the more acute Sound, i. e. that the Acuteness increaseth

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as the Length diminisheth; and therefore the Ratios of these Lengths are just Measures of the Intervals of Tune, whatever be the immediate Cause of the Differences, or whatever Proportion be betwixt the Lengths of the Chords and their Vibrations. So far he owns we are upon a good Foundation as to the arithmetical Part of this Science; but then in Philosophy we ought to come as hear the immediate Cause of Things as possibly we can; and where we cannot have a positive Certainty, we must take the most reasonable Supposition; and of that we judge by its containing no obvious Contradiction; and then by its Use in explaining the Phenomena of nature; how well the present Hypothesis has explained the sensible Unity of Tune in a given Sound we have already heard, and the Success of it in the Things that follow will further confirm

I shall end this Part with observing, that as the Lengths of Chords determine the Measure of the Velocity of their Vibrations, and this determines the Measure of their Gravity and Acuteness, so 'tis thus that Harmony is brought under Mathematical Calculation; the True object of the Mathematical Part of Musick being the Quantity of the Intervals of Sounds; which are capable of various Additions, Substractions, Gr., as other Quantities are; the performed in a Manner suitable to the Nature of the Thins.

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CHAP. III.

- Of the Nature of CONCORD and DISCORD as contained in the Causes thereof.
 - 5 1. Wherein the Reasons and Characteristicks of the several Differences of Concords and Discords are enquired into.

fon of the Differences of Tune, and the Measures of these Differences, or of the Intervals of Sound arising from them: We now enquire into the Grounds and Reasons of their different Effects. When Two Sounds are heard in immediate Succession, the Mind not only perceives Two simple Ideas, but by a proper Activity of its own, comparing these Ideas, forms another of their Difference of Tune, from which arise to us various Degrees of Pleasure or Offence; these are the Estects we are now to consider the Reasons of.

But it will be fit in the First Place to know what is mean'd by the Question, or what we propose and expect to find; in order to this observe, That there is a great Difference betwixt knowing what it is that pleases us, and why we are pleased with such a Thing; Please

fure

fure and Pain are fimple Ideas we can never make plainer than Experience makes them for they are to be got no other Way; and for that Question, Why certain Things please and others not, as I take it, it fignifies this, viz. How do these Things raise in us agreeable or disagreeable Ideas? Or, What Connection is there betwixt these Ideas and Things? When we consider the World as the Product of infinite Wisdom, we can say, that nothing happens without a sufficient Reason, I mean, that whatever is, its being rather than not being is more agreeable to the infinite Perfection of Goo, who knew from Eternity the whole Extent of Possibility, and in his perfect Wisdom chose to call to a real Existence such Beings, and make fuch a World, as should answer the best and wifest End. The Actions of the SUPREME BEING flow from eternal Reasons known and comprehensible only to his infinite Wildom; and here lies the ultimate Reason and Cause of every Thing. To know how perfect Wildom and Omnipotence exerted it felf in the Production of the World; to find the original Reason and Grounds of the Relations and Connection which we fee among Things, is altogether out of the Power of any created Intelligence; but not to carry our Contemplation beyond what the present Subject requires, I think the Reason of that Connection which we find by Experience betwixt our agreeable and difagreeable Ideas, and what we call the Objects of Sense, our Philosophy will never reach; and for any E 2 Thing

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Thing we shall ever find (at least in our mortal State) I believe it will remain a Question whether that Connection flows from any Necessity in the Nature of Things, or be altogether an arbitrary Disposition; for to solve this, would require to know Things perfectly, and understand their whole Nature; which belongs only to that GLORIOUS BEING on whom all others depend. We shall therefore, as to this Question, be content to fay, in the general, that 'tis the Rule of our Constitution, whereby upon the Application of certain Objects to the Organ of Sense, considered in their prefent Circumstances, an agreeable or disagreeable Idea shall be raised in the Mind. We have a confcious Perception of the Existence of other Things besides our selves, by the irresistible Impressions they make upon us; if the Effect is Pleasure we pursue it farther; if it is Pain we far less doubt of the Reality: And fo in our Enquiries into Nature, we must be satisfied to examine Observations already made, or make new ones, that from Nature's constant and uniform Operations we may learn her Laws. Things are connected in a regular Order; and when we can discover the Law or Rule of that Order, then we may be faid to have discovered the secondary Reason of Things, for Example, tho' we are forced to refolve the Canfe of Gravitation into the arbitrary Will of GOD; yet having once discovered this Rule in Nature, that all the Bodies within the Atmosphere of the Earth have a Tendency down ward

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ward perpendicularly as to a common Centre within the Earth, and will move towards it in a Right Line, if no other Body interpofes; upon this Principle we can give a good Reason why Timber floats in Water, and why Smoke ascends. I call it a secondary Reason, because is is founded on a Principle of which we can give no other Reason but that we find it constantly so. Accordingly in Matters of Sense we have found all we can expect, when we know with what Conditions of the Object and Organs of Sense our Pleasure is connected; so in the Harmony of Sounds we know by Experience what Proportions and Relations of Tune afford Pleasure, what not; and we have also found how to express the Differences of Tune by the Proportion of Numbers; and if we could find any Thing in the Relation of these Numbers, or the Things they immediately represent, with which Concord and its various Degrees are connected; by this Means we hould know where Nature has fet the Limits of Concord and Discord; we should with Certainty determine what Proportions constitute Concord, and the Order of Perfection in the various Degrees of it; and all other Relations would be left to the Class of Discords. And this think is all we can propose in this Matter; to that we don't enquire why we are pleased, but what it is that pleases us; we don't enquire why, for Example, the Ratio of 1:2 constitutes Concord, and 6: 7 Discord, i. e. upon what original Grounds agreeable or disagreeable Idea's are connected with these Relations; and the

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proper Influence of the one upon the other; but what common Property they agree in that make Concord; and what Variation of it makes the Differences of Concord; by which we may also know the Marks of Discord : In Short, I would find, if possible, the distinguishing Character of Concord and Discord; or, to what Condition of the Object these different Effects are annexed, that we may have all the Certainty we can, that there are no other Concords than what we know already; or if there are we may know how to find them; and have all poffible Affiftance, both from Experience and Reason, for improving the most innocent and ravishing of all our fenfual Entertainments; and as far as we are baffled in this Search, we must sit down content with our bare experimental Knowledge, and make the best Use of it we can. Now to the Question.

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Concord besides these, yet none less than 2: r, (the Octave) or whose acute Term is greater than; nor any greater than Octave, or whose acute Term is less than; but what are composed of the Octave and some lesser Concord, which is all

the Judgment of Experience.

I suppose it agreed to that the vibratory Motion of a Chord is the Cause, or at least proportional to the Motion which is the immediate Cause of its Sound; we have heard already that the Vibrations are quicker, i. e. the Courses and Recourses are more frequent, in a given Time, as the Chord is shorter; I have observed also that acute and grave are but Relations, tho there must be something absolute in the Cause of Sound, capable of less and more, to be the Ground of this Relation which flows only from the comparing of that less and more; and whether this be the absolute Velocity of Motion, or the Frequency of Vibrations, I have also considered, and do here assume the last as more probable. We have also proven that the Lengths of Chords are reciprocally as the Numbers of Vibrations in the same Time; and therefore their Ratios are the true Measures of the Intervals of Sound. But I shall apply the Ratios immediately to the Numbers of Vibrations, and examine the Marks of Concord and Discord upon this Hypothefis.

Now then, the universal Character whereby Concord and Discord are distinguished, is to be sought in the Numbers which contain and express the Intervals of Sound: But not in these

Num-

bers abstractly; we must consider them as expressing the very Cause and Difference of Sound with respect to Tune, viz. the Number of Vibrations in the same Time: I shall therefore pass all these Considerations of Numbers in which nothing

has been found to the present Purpose.

UNISONS are in the First Degree of Concord, or have the most perfect Likeness and Agreement in Tune; for having the same Measure of Tune they affect the Ear as one simple Sound; yet I don't fay they produce always the best Effect in Musick; for the Mind is delighted with Variety; and here I consider simply the Agreement of Sounds and the Effect of this in each Concord singly by it felf. Unisonance therefore being the most perfect Agreement of Sounds, there must be something in this necessary to that Agreement, which is to be found less or more in every Concord. The Equality of Tune (exprest by a Ratio of Equality in Numbers) makes certainly the most perfect Agreement of Sound; but yet 'tis not true that the nearer any Two Sounds come to an Equality of Tune they have the more Agreement, therefore 'tis not in the Equality or Inequality of the Numbers simply that we are to feek this fecondary Reason of the Agreement or Disagreement of Sounds, but in some other Relation of them, or rather of the Things they express.

Is we consider the Numbers of Vibrations made in any given Time, by Two Chords of equal Tune, they are equal upon the Hypothesis laid down; and so the

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Vibrations of the Two Chords coincide or begin together as frequently as possible with respect to both Chords, viz. at the least Number possible of the Vibrations of each; for they coincide at every Vibration: And in this Frequency of Coincidence or united Mixture of the Motions of the Two Chords, and of the Undulations of the Air caused thereby, not in the Equality or Inequality of the Number of Vibrations, must we feek the Difference of Concord and Discord; and therefore the nearer the Vibrations of Two Strings accomplished in the fame Time, come to the least Number possible, they feem to approach the nearer to the Condition, and confequently to the Agreement of Unifons. Thus far we reason with Probability, but let us fee how Experience approves of this Rule.

Is we take the natural Series 1, 2, 3, 4, 5; 6, and compare every Number to the next, as expressing the Vibrations (in the same Time) of Two Chords, whose Lengths are reciprocally as these Numbers; we find the Rule holds exactly, for 1:2 is best than 2:3, &c. and the Agreement diminishes gradually; so that after 6 the Consonance is unsufferable, because the Coincidences are too rare; but there are other Ratio's that are agreeable besides what are found in that continued Order, whereof I have already mentioned these Two, viz. 3:5, and 5:8 which with the preceeding Five are all the concording Intervals within, or less than Octave 1:2. i. e. whose acute Term is greater

than

A TREATISE CHAP. III. than i, the Fundamental being 1. Now to judge of these by the Rule laid down; 3:5 will be preterr'd to 4:5, because being equal in the Number of Vibrations of the acuter Term, there is an Advantage on the Side of the Fundamental in the Ratio 3: 5, where the Coincidence is made at every Third Vibration of the Fundamental, and 5th of the acute Term: Again as to the Ratio 5:8'tis less perfect than 5:6, because tho' the Vibrations of the fundamental Term of each that go to one Coincidence are equal; yet in the Ratio 5:6 the Coincidence is at every 6 of the acute Term, and only at every 8 in the other Cafe. Thus does our Rule determine the Preference of the Concords already mentioned; nor doth the Ear contradict it; fo that these Concords stand in the Order of the following Table, where I annex the Names that these Intervals have in Pra-Rice, and which I shall hereafter assume till we

come to the proper Place for explaining the

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Now you must observe that this Frequency of Coincidence does not respect any absolute Space of Time; for 'tis still an Octave, for Example, whatever the Lengths of the Chords are, if they be to one another as 1:2; and yet 'tis certain that a longer Chord, cateris paribus, takes longer Time to every Vibration: It has a Respect to the Number of Vibrations of both Chords accomplished in the same Time: It does not respect the Vibrations of the Fundamental only, for then 1:2 and 1:3 would be equal in Concord, and so would these 4: 7 and 4:5 which they are not nor can be; for where the Ratios differ there must the Agreement differ from the very Nature of the Thing, because it depends altogether on these Ratios; so that equal Agreement must proceed from an equal (i. e. from the same) Ratio; nor can itrespect the acuter Term only, else 3:5 and 4:5 would be equal; therefore necessarily a Consideration must be made of the Number of Vibrations of both Chords accomplished in equal Time. And if from the known Concords within an Octave, we would make a general Rule, it is this, viz. that when the Coincidences are most frequent with respect to both Chords (i. e. with respect to the Numbers of Vibrations of each that go to every Coincidence) there is the nearest Approach to the Condition of Unifons: So that when in Two Cafes we compare the fimilar Terms (i. e. the Number of Vibrations of the Fundamental of the one to that of the other,

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and the acute Term of the one to the acute Term of the other) if both similar Terms of the one are less than these of the other, that one is preferable; and any one of the fimilar Terms equal and the other unequal, that which has the least is the preferable Interval, as we find by the Judgment of the Earin all the Concords of the preceeding Table.

Now if this be the true Rule of Nature, and an univerfal Character for judging of the comparative Perfection of Intervals, with respect to the Agreement of their Extremes in Tune; then it will be approven by Experience, and answer every Case: But it is not so, for by this Rule 4:7 or 5:7, both Discords, are preferable to 5:8 a Concord, tho' indeed in a low Degree; and 1: 3, an Oftave and Fifth compounded, will be preferable to 1: 4 a double Octave, contrary to Experience. But suppose the Rule were good as to fuch Cases where both fimilar Terms of the one Cafe compared are less than these of the other, or the one similar Term equal and the other not; yet there are other Cases to which this Character will not extend, viz. when there is an Advantage (as to the Smalness of the Number of Vibrations to one Coincidence) on the Part of the Fundamental in one Case, and on the Part of the acute Term in the other; which Advantage may be either equal or unequal, as here 5:6 and 4: 7; the Advantages are equal, the Coincidence in the First being made fooner, by Two Vibrations of the Fundamental, than in the Second

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Second, which again makes its Coincidences fooner by 2 Vibrations of the acute Term. If we were to draw a Rule from this Comparison, where the Ear prefers 5:6 a 3d lesser, to 4:7 a Discord, then we should always prefer that one of Two Cases whose mutual Advantages are equal, which coincides at the least Number of Vibrations of the acute Term. But Experience contradicts this Rule, for 3: 8, an Octave and 4th compounded, is better than 4:7; fo that we have nothing to judge by here but the Ear. If laftly, the mutual Advantages are unequal, we find generally that which has the greatest Advantage in whatever Term is preferable, tho' tis uncertain in many Cases. Upon the Whole I conclude that there is fomething besides the Frequency of Coincidence to be confidered in judging of the comparative Perfection of Intervals; which lies probably in the Relation of the Two Terms of the Interval, i.e. of their Vibrations to every Coincidence; fo that it is not altogether leffer Numbers, but this joined with fomething else in the Form of the Ratio, which how to express so as to make a complete Rule, no Body, that I know, has yet found.

As to the Concords of the preceeding Table fome have taken this Method of comparing them: They find the relative Number of Coincidences that each of them makes in a given Time, thus, Find the least common Dividend to all the Numbers that express the Vibrations of the Fundamental to one Coincidence; take this for a Number of Vibrations made in any Time by a common fundamental Chord; if it is divided feverally by the Numbers whose common Dividend it is, viz. the Terms of the feveral Ratios that express the Vibrations of the Fundamental to one Coincidence; the Quotes are the relative Numbers of Coincidences made in the same Time by the several Concords; thus, the common Dividend mentioned is 60, and it is plain while the common Fundamental makes 60 Vibrations, there are 60 Coincidences of it with the acute Octave, and 30 Coincidences with the 5th, and fo on as in the Table annexed.

THE Preference in this Ratios (Coin. Method is according to 8ve, 12: 1 60 greater Number of Co- 5th, 3:2 30 incidences, and where 4th, 4:3 20 that is equal the Prefe- 6th gr. 5:3 20 rence is to that Interval 3d gr. 5:4 15 whose acutest Term has 3d less. 6:5 12 fewer Vibrations to one 6th left, 8:5

Coincidence. And fo the

Order here is the same as formerly determined; but we are left to the same Difficulties and Uncertainty as before; for this Rule refers all to the Confideration of the Vibrations of the Fundamental to one Coincidence; and therefore of Two Cases that whose lesser Term is least will be preferable, whatever Difference there be of the other Term, which is contrary to Experience.

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Mersennus, in his Book I. of Harmony, Art. 1. of Harmonick Numbers, has a Proposition which promifes an universal Character, for distinguishing the Perfection of Intervals as to the 2

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to he the Agreement of their Extremes in Tune: The Substance of the whole Art. I shall give you briefly in the feveral Propositions of it, because it may help to explain or confirm what I have delivered; and then I shall examine that particular Proposition which respects the Thing directly before us; he tells us, That, 1mo. Every Sound has as many Degrees of Acuteness as it confists of Motions of the Air, i.e. as oft as the Tympan of the Ear is struck by the Air in Motion. 'Tis plain he means that the Degree of Acuteness depends on the Number of Vibrations of the Air, and consequently of the sonorous Body, accomplished in a given Time, agreeable to what I have faid of it above, elfe I do not understand the Sense of the Proposition. The Perception of Concord is nothing but the comparing of Two or more different Motions, which in the same Time affect the auditory Nerve. stio. We cannot make a certain Judgment of any Confonance until the Air be as oft struck in the same Time, by Two Chords, or other Instruments, as there are Unites in each Number, expressing the Ratio of that Concord: For Example, We cannot perceive a 5th, till 2 Vibrations of the one Chord, and 3 of the other are accomplished together, which Chords are in Length as 3 to 2. 4to. The greater Agreement and Pleasure of Consonance arises from the more frequent Union (or Coincidence) of Vibrations. But, observe, this is said without determining what this Frequency has respect to; how incomplete a Rule it is, I think we have already

CHAP. III.

of

already feen. 5to. That Number of Motions (or Vibrations) is the Cause that the arithmetical Division of Consonancies (or Intervals) has more agreeable Effects than the harmonical; but this cannot be undrestood till afterwards. Now follows the Proposition which is the 4th in Mersennus, but placed last here, because 'tis what I am particularly to examine. 6to. The more simple and agreeable Consonancies are generated before the more compound and harsh, Example. Let 1, 2, 3, be the Lengths of Three Chords, 1:2. is an Octave, 2:3 a 5th; and it is plain 1:3 is an Octave and 5th compounded, or a Twelfth. But the Vibrations of Chords are reciprocally as their Lengths, therefore the Chord 2 vibrates once while the Chord 1 vibrates twice, and then exists an Octave; but the 12th does not yet exist, because the Chord 3 has not vibrated once, nor the Chord I vibrated thrice (which is necessary to a 12th;) again for generating a 5th, the Chord 2 must vibrate thrice, and the Chord 3 twice, which cannot be unless the Chord 1 in the same Time vibrate 6 Times, and then the 12th will be twice produced, and the Octave thrice, as is manifest; for the Chord 2 unites its Vibrations sooner with the Chord I than with the Chord 3, and they are fooner confonant than the Chord I or 2 with 3. Whence many of the Mysteries of Harmony, viz. concerning the Preference of Concords and their Succession may be deduced, by the fagacious Practifer, Thus far Mersennus; and Kircher repeats his very Words. But

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Bur when we examine this Proposition by other Examples, it will not answer; and we are as far as ever from the universal Character fought. Take this Example, 2:3:6, the very fame Intervals with Mersennus's Example, only here the Octave is betwixt the Two greatest Numbers, which was formerly betwixt the Two lesser; now here the Chord 2 unites every Third Vibration with every Second Vibration of the Chord 3, and then the 5th exists; but also at every Third Vibration of the same Chord 2 there is a Coincidence of every fingle Vibration of the Chord 6 (because as 2 to 6 so 1 to 3) and then doth the 12th exist, and also the Octave, because at every second Vibration of the Chord 3, and every fingle Vibration of the Chord 6, there is an Octave; so that in 3 Chords whose Lengths are as 2: 3: 6, containing the Octave: 5th: 12th, all the Three are generated in the fame Time, viz. while the Chord 2 makes Three Vibrations; for when the Chord 3 has made Two, precifely then the 5th exists; at the same Time also the Chord 6 has made Vibration, and then doth the 12th first exist: But while the Chord 3 vibrates twice (i.e. while the Chord 2 vibrates thrice) the Chord 6 vibrates once, and not till then doth the Octave exist. From this Example 'tis plain the Proposition is not true in the Sense in which Mersennus explains it, or at least, that I can understand it in: It is true that taking the Series 1, 2, 3, 4, 5, 6, 8, and comparing every Three of them immediately next other in the Manner

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of the preceeding Example, the Preference will be determined the same way as has been already done, viz. Octave: 5th: 4th: 6th, greater; 3d greater, 3d leffer, 6th leffer: But yet it will not hold of the very same Concords taken another way, as is made fufficiently plain in the last Example, Take this other, 6: 4: 3, containing a 5th, 4th, and Octave; while the Chord 4 makes 3 Vibrations, the Chord 3 makes 4 Vibrations; and then there is a 4th: Also while the Chord 4 make 3 Vibrations, the Chord 6 makes 2 Vibrations and then there is a 5th: So that we have here a 5th and 4th generated in the fame Time tho' if you take the same Concords in another Order, thus, 2:3:4; then the Rule will hold Take lastly this Example: Suppose Three Chords a:b:c, where a:b, is as 4:7, and b:c as 5:6, while b vibrates 4 Times, a vibrates 7 Times, and then that Discord 4: exists; but the 3d lesser, 5: 6, is not generated til b has vibrated 6 Times, fo that the Discont 4: 7 is generated before the Concord 5: 6. It will be so also if you take them thus; suppose a: as 8:5, and a: c as 7:4, here the Discord exist whenever a has made 4 Vibrations, and the Concord not till a has made 5 Vibrations. Now this were a just Rule, it would certainly answer in all Positions of the Intervals with respect to one another, which it does not; or there mul be a certain Order wherein we ought to take them; but no one Rule with respect to the Order will make this Character answer to Ex perience in every Cafe. NOW

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Now after all our Enquiry for an universal Character, whereby the Degrees of Concord may be determined, we are left to our Experience, and the Judgment of the Ear. We find indeed that where the radical Numbers which express any Interval are great, it is always grois Discord; and that all the Concords we know are exprest by small Numbers : And of all the Concords within an Octave, these are best which are contained in smallest Numbers; hat we may eafily conclude that the frequent Coincidences of Vibrations is a necessary Condition in the Production of Harmony; but still we have no certain general Rules that afford in universal Character for judging of the Agreement of any Two Sounds, and of the Degree of their Approach to the Perfection of Unisons; which was the Thing we wanted in all this Enquiry: However, as to the Use of what we have already done, I think I may fay, that in Philosophical Enquiry, all our Pains is not oft, if we can fecure our felves from false and ncomplete Notions, and taking fuch for just ind true; not that I say 'tis a wrong Notion of he Degrees of Concord, to think they depend pon the more and less frequent uniting the Virations, and the Ear's being consequently more or less uniformly moved; for that this Mixture and Union of Motions is the true Principle, or it least a chief Ingredient of Concord, is sufficiently plain from Experience; but I speak thus, the Ex ecause there seems to be something in the Proportion of the Two Motions that we have not

yet found, which ought to be known, in order to our having an univerfal Rule, that will infallibly determine the Degrees of Concord, agreeable to Sense and Experience. And if any Body can be satisfied with the general Reason and Principle of Concord and Discord already found, they may take this Definition, viz. That Concord is the Refult of a frequent Union and Coincidence of the Vibrations of Two Sonorous Bodies, and confequently of the undulating Motions of the Air, which being caused by these Vibrations, are like and proportional to them; which Coincidence the more frequent it is with re-spect to the Number of Vibrations of both Bodies performed in the Same Time, cæteris paribus, the more perfect is that Concord, till the Rarity of the Coincidence in respect of one both the Motion's become Discord.

I can find no better or more particular Account of this Matter among our modern Enquirers; you have already heard Mersennus, and I shall give you Dr. Holder's Definition in his own Words, who has written chiefly on this One Point, as the Title of his Book bears: Says he, "Consonancy (the same I call Concord) is the Passage of several tunable Sounds through the Medium, frequently mixing and uniting in

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Medium, frequently mixing and uniting in their undulated Motions caused by the well proportioned commensurate Vibrations of the

"fonorous Bodies, and confequently arriving "finooth and fweet and pleasant to the Ear.

"On the contrary, Dissonancy is from disproportionate Motions of Sounds, not mixing, but

tionate Motions of Sounds, not mixing, but

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" jarring and clashing as they pass, and arriving " to the Ear harsh and grating and offen-" five.' If the Dr. means by our Pleasure's being a Consequence of the frequent Mixture of Motions, any other Thing than that we find these Things so connected, I do not conceive it; but however he understood this, he has applied his Definition to the Preference of Concord no further than these Five, 1:2, 2:3, 3:4,5:4,5:6. Yet after all I hope we shall, in what follows, find other Considerations to fatisfie us, that we have discovered all the true natural Principles of musical Pleasure, with respect to the Harmony of the different Tunes of Sound; and I should have done with this Part, but that there are some remarkable Phenomena, depending on the Things already explained, which are worth our Observation.

^{9 2.} Explaining some remarkable Appearances relating to this Subject, upon the preceeding Grounds of Concord.

TF a Sound is raifed with any confiderable Intenfeness, either by the human Voice, or from any fonorous Body; and if there is another fonorous Body near, whose Tune is unison or octave above that Sound, this Body will also found its proper Note unison or octave to the given Note, the' nothing visibly has touched it. The Experiment can be made most sensibly with the Strings of a musical Instru-

strument; for if a Sound is raised unison or offave below the Tune of any open String of the Instrument, it will give its Sound distinctly. And we might make a pleasant Experiment with a strong Voice singing near a well tuned Harpsichord. We find the same Phenomenon by raising Sound near a Bell, or any large Plate of fuch Metal as has a clear and free Sound; or a large chrystal drinking Glass. Now our Philosophers make Use of the Hypothesis already laid down to explain this furprizing Appearance; they tell us, That, for Example, when one String is struck, and the Air put in Motion, every other String within the Reach of that Motion receives some Impression from it; but each String can move only with a certain determinate Velocity of Recourses in vibrating, because all the Vibrations from the greatest to the least are equidiurnal; again, all Unisons proceed from equal or equidiurnal Vibrations, and other Concords from other Proportions, which as they are the Cause of a more perfect Mixture and Agreement of Motion, that is, of the undulated Air, so much better is that Concord and nearer to Unison: Now the unison String keeping an exact equal Course with the sounded String, because it has the same Measure of Vibrations, has its Motion continued and improven till it become sensible and give a distinct Sound; and other concording Strings have their Motions propagated in different Degrees, according to the Commensurateness of their Vibrations with these of the sounded String; the Offace

Octave most sensibly, then the 5th; but after this the croffing of the Motions hinders any fuch Effect: And they illustrate it to us in this Manner; suppose a Pendulum set a moving, the Motion may be continued and augmented, by making frequent light Impulses, as by blowing upon it, when the Vibration is just finished and the Pendulum ready to return; but if it is touched before that, or by any cross Motion, and this done frequently, the Motion will be so interrupted as to cease altogether; so of Two unison Strings, if the one is forcibly struck it communicates Motion by the Air, to the other; and being equidiurnal in their Vibrations, they finish them precisely together; and the Motion of that other is improven by the frequent Impulses received from the Vibrations of the First, because they are given precisely when that other Chord has finished its Vibrations, and is ready to return; but if the Two Chords are unequal in Duration, there will be a croffing of Motions less or more, according to the Proportion of that Inequality; and in some Cases the Motion of the untouched String is fo checked as never to be fensible, or at least to give any Sound; and in Fact we know, that in no Case is this Phanomenon to be found but the Unison, Octave and Fifth; most fensibly in the First, and gradually less in the other Two, which are also limited to this Condition, that the graver will make the acuter Sound, but not contrarily. And as this is a tolerable Explication of the Matter, it confirms in a great Degree the

Truth of the Equidiumity of the Vibrations of the fame Chord, and the Proportion of the Lengths and Duration of the Vibrations; for we know that the Sound of the untouched Chord is weaker than that of the other, and its Vibrations confequently less; now if they were not equidiurnal, and if the Proportion mentioned were not also true, we should not have so good a Reason of the Phanomenon, which joyned with the fenfible Identity of the Tune, is sufficient without other Demonstrations to make it highly probable that the Vibrations are all performed in equal Time, and that the Duration of a fingle Vibration of the one is to that of the other directly, or the Number of Vibrations in a given Time reciprocally as the Lengths of the Chords (cateris paribus.)

II. I cannot omit to mention in this Place, how the Gentlemen of the Academy of Sciences in France apply this Hypothesis of karmonick Motion, for explaining the strange Recovery of one who has been bitten by the Tarantula, the Effect of which is a Lethargy and Stupifying of the Senses; I shall not here repeat the whole Story, but in fhort, the Recovery is by Means of Musick; 'tis not every Kind that will recover the fame Person, nor the same Kind every Perfon; but having tried a great many various Measures and Combinations of Tune and Time, they hit at random on the Gure, which excites Motion in the Patient by Degrees, till he is recovered. To account for this, these Philofophers tell us, that there is a certain Aptness to

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in these particular Motions, to give Motion to the Nerves of that Perfon (for they suppose the Disease lies all there) in their present Circumstances, as one String communicates Motion to another, which neither a greater nor lefler, nor any other Combination can do being excited to Motion the Senses return gradually.

III. THERE are other Instances of this wonderful Power, and, if I may call it so, sympathetick Virtue in fonorous Motions; I have felt a very fensible tremulous Motion in some Parts of my Body when near a bass Violin, upon the founding of certain Notes strongly struck, tho' the Sound of a Cannon would not produce such an Effect. And from all our Observations we are assured that it is not a great or frong Motion in the Parts of one Body that is capable to produce Motion by this Kind of Communication in the Parts of another, but it depends on a certain inexpreffible Likeness and Congruity of Motions; whereof take this one Example more, which is not less surprising than the rest: If a Man raises his Voice unison to the Tune of a drinking Glass, and continue to blow for fome time in it with a very intense or strong Voice, he shall not only make the Glass found, but at last break it; whereas a Motion much stronger, if it is out of Tune to the Glass, will nevermake it found and far less break it(I have known persons to whom this Experiment succeeded.) The Reason of this feems very probably to be, that when the Glass founds, its Parts are put into a vibratory or tremulous Motion, which being continued long by

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by a strong Voice, their Cohesion is quite broken; but suppose another Voice much stronger, yet if tis out of Tune, there will be fuch a croffing of Motions that prevents both the Sound of the Glass and the breaking of it. It is a noted Experiment, that by pressing one's Finger upon the Brim of a Glass, and so moving it quickly round, it will found; and to demonstrate that this is not effected without a very swift Motion of the infensible Parts of the Glass, we need but fill fome Liquor into it, and then repeating the Experiment, we shall have the Liquor put gradually into a greater Motion, till the Glass found very diffinctly, and continuing it with a brisk Motion, the Liquor will be put into a very Ferment. The Confideration of this may perhaps make the Explication of the last Case more reasonable.

IV. DOCTOR Holder, to confirm his general Reafon of Confonancy alledges some Experiments that happened to himfelf, particularly, fayshe, "Being in an arched founding Room " near a shrill Bell of a House-clock, when the A-" larm flruck I whiftled to it, which I did with " Ease in the same Tune with the Bell; but " endeavouring to whistle a Note higher or lower, " the Sound of the Bell and its cross Motions " were fo predominant, that my Breath and "Lips were shecked, fo that I could not " whiftle at all, nor make any Sound of it in that discording Tune. After I founded a "thrill whiftling Pipe, which was out of Tune to the Bell, and their Motions so clashed that

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" that they feemed to found like fwitching one " another in the Air." To confirm this of the Doctor's, there is a common Experiment, that if Two Sounds, suppose the Notes of a Instrument, are brought to unifon Octave or 5th, and then one of them raised or depressed a very little, there will be a Clashing of the Two Sounds, like a Beating, as if they strove together; and this will continue till they are restored to exact Concord, or carried a little further from it, for then also this Beating will cease, tho' the Discord will perhaps increase. Now if we consider that Concords are fuch a Mixture and Agreement of Sounds that the compound feems not to partake more of the one Simple than of the other, but they are so evenly united that the one does not prevail over the other so as to be more observable; We see that this striving, in which we find an alternate prevailing of either Sound, ought naturally to happen when they are nearest to their most perfect Agreement, but when they are farther removed, the one has gained too much upon the other not to make that one most observable. All these Things serve to show us how necessary an Ingredient in the Cause of Concord the Union and Conicidence of the Motions is, and I shall beg a little more of your Patience to confider the following Illustration.

It is not an unpleasant Entertainment to contemplate the beautiful Uniformity of Nature in her several Productions; the Resemblance difcovered among Things, if it don't let us farther

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into the Knowledge of the Essence and original Reason of them, it does at least increase our Knowledge of the common Laws of Nature; and we are helped to explain and illustrate one Thing by another. To the Matter in Hand, we may compare Sight and Hearing, and to manage the Comparison to greatest Advantage, let us consider, Sensation is the same Thing with respect to the Mind that perceives, whatever be the Instrument of Sense, i. e. without distinguishing the external Sense (as Philosophers speak) the internal is the same, which is properly Senfation, as this implies a certain Mode of the Mind caused by the Admittance (or, with Mr. Lock, the actual Entrance) of an Idea into the Understanding by the Senses; which is a Definition plainly unconfin'd to one or other of the Five Ways whereby Ideas enter, when the Mind is faid to perceive by the Senses; hence we have good Reason to think, that it is not improper to compare one Sense with another, as Seeing and Hearing; for tho' their Objects are different, and the Means whereby they make their Impression on the Mind be fuited to them, by which Senfations very distinct are produced; yet they may be equally agreeable in their Kind, and have fome common Principle in both Cases necessary to that Agreeableness. We believe that Nature works by the most simple and uniform Ways; accordingly we find by Experience that simple Ideas have a much easier Access than compound; and the more Difficulty the less Pleasure; yet the more easy are

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are not always the most agreeable; for as we have no Pleasure in what falls confusedly on the Senses, and wearies the Mind with the manifold and perplex'd Relations of its Parts; neither does that afford much Pleasure that is too easily perceived, at least we are soon cloyed with it; but a middle betwixt these Extremes is best. Again, we know that Variety entertains, both of simple Ideas and these variously connected and joyned together: And because the Mind is best pleased with Order, Uniformity, and the distinct Relation of its Ideas, the compound Idea ought to have its Parts uniform and regularly connected, and their Relations fo distinct that the Mind may perceive them without Perplexity: In short, when the Cause is most uniform, and involves not too great Multiplicity in the Senfation, the Idea will be entertained with the more Pleafure; hence it is that a very intricate Figure, perplex'd with many Lines, and these not very regular, nor their Ratios distinct, does not please the Eye so well as a Figure of fewer Lines and in a more distinct Relation.

But the Comparison must run between the Eye and Ear in Perceptions that have fomething common: Motion is the Object of Sight very properly; and tho' it be not fo of Hearing immediately; yet Sound being the immediate Product of Motion, we may conclude that if the Eye is gratify'd with the Uniformity of Motion, for the same Reason (whatever it be in its felf) will the Ear be with Uniformity in Sounds: Sounds, which ow themselves to Motion, and are in a Manner nothing else but Motion forcing on us a Perception of its Existence by other Organs than the Eye, and therefore makes that different Idea we call Sound. In Seeing the Thing is plain; for if Two Motions are at once in our View, where the Sense attends to nothing but the Motion, then, as the Relation of the Velocities is more distinct, we compare the Motions, and view them with the greater Pleasure; but were the Relation less sensible, there could but little Pleasure arise from these Ideas: Thus, were it obvious that the one Motion were to the other as 2: 1 or 3: 2 uniformly and constantly, we could look on them with Delight; but were the Ratio less perceiveable as 13: 7; or the one being uniform Motion, and the other irregularly accelerate; the Mind would weary in the Comparison, and perhaps never reach it, therefore find no Pleasure: I do not fay that in many Cafes, which might be viewed with Satisfaction, we could be determinately fure what were the Ratio of Velocity; but from Experience we know, that the more commensurable the Extremes are to one another, it is the more agreeable, because distinct; therefore it is certain we perceive the one more than the other: And in many Cafes there would be a Pain in viewing fuch Objects, the Irregularity of the Motion creating a Giddiness in the Brain, while we endeavour to entertain both the Motions; and by Experience we know

know, that to follow very quick Motions with the Eye, especially if circular, this is constantly the Effect. It is the same Way in Hearing, some simple Sounds are painful and harsh, because the Quickness of the Vibrations bears no Proportion to the Organs of Sense, which is necessary to all agreeable Sensation. But we have a particular Example that comes nearer the

Purpofe.

LET us view the Motion of Two Pendulums; if they are of equal Length, and let fall from equal Height they describe equal Arches; their Motions continue equal Time, and their Vibrations begin always together: The Motions of these Two Pendulums are like and equal fo that if we suppose the Eye to follow the one. and describe an equal Arch with it (which would be if the vifual Ray in every Point of the Arch were perpendicular to the pendulum Chord) then that one would always eclipse the other, and the Eye perceive but one Motion; and suppose the Eye at a considerable Distance, it would not perceive Two different Motions, tho' it felf moved not; confequently there could be no jarring of these Ideas: This is exactly the Case of Two Chords every way the same, and equally impelled to Motion; for their Vibrations give the Parts of the Air alike and equal Motion, fo that the Ear is always struck equally and at the same Time, hence we perceive but one simple Sound; and with respect to the Effect it is no more a compound Idea than Two Bottles of Water from the fame Fountain make

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a compound Liquor, which only increase the Quantity; as the foresaid Unisons only fill the Ear with a greater Sound increasing the Intenfeness.

Is in the same Case we suppose the Eye so situated as to see distinctly the Motion of both Pendulums; or suppose the Pendulums fall from different Heights, then this Variety would afford a greater Pleafure; for the Mind perceives a Difference, but a very distinct Relation; because we see the Vibrations begin always at the same Time; and this explains the greater Pleasure we have in Unisons which proceed from Chords differing in some Circumstances, as if the one were more intense or of a different Species; in which we perceive the Unity of Acuteness, but these other different Circumstances make them perceiveably distinct simple Sounds, which heightens the Pleasure. If we carry this Comparison further, we'll find, that if Two Pendulums of unequal Length be let fall together from similar Points of their Arch, they begin not every Vibration together, but they will coincide more or less frequently, according to a certain Proportion of their Lengths, which is always reciprocally subduplicate; and tho' this is quite another Proportion than that of simple Chords which are in reciprocal simple Proportion of their Number of Vibrations to every Coincidence, yet the Illustration drawn from this Comparison stands good, because we consider only the Ratios of the Number of Vibrations to each Coincidence in both Cafes; and in this we find it true in general, that the more

more frequently the Vibrations coincide, the Profpect is the more agreeable; but it is also according
to the Number of Vibrations of both Pendulums in the same Time, in so much that the
same Numbers which make less or more Concord
in Sound, will also give a greater or less pleasant
Prospect, if the Pendulums are so proportioned,
according to the known Laws of their Motion;
and if the Pendulums seldom or never coincide, or
begin their Vibrations together, there will be
such a thwarting of the Images as cannot
miss to offend the Sight.

CHAP. IV.

Containing the Harmonical Arithmetick.

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of the Theory of Numbers as is necessary to be known, for making and understanding the Comparisons of musical Intervals, which are express by Numbers; in order to our finding their mutual Relations, Compositions and Resolutions. But I must premise Two Things. First: That I suppose the Reader acquainted with the more general and common Properties and Operations of Numbers; so that I shall but barely propose what of these I have Use for, without any Demonstration, and demonstrate Things that are less

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less common. Second. That I confine my felf to the principal and more necessary Things; leaving a Thousand Speculations that may be made, as less useful to my Design, and also because these will be easily understood when you meet with them, if the fundamental Things here explained be well understood.

§ 1. Definitions.

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the images as cannot

HERE is a twofold Comparison of Numbers, in both of which we distinguish an Antecedent or Number compared, and Consequent or Number to which the other is compared. By the First we find how much they differ, of by how many Units the Antecedent exceeds or comes short of the Consequent; which Difference is called the arithmetical Ratio (or Exponent of the arithmetical Relation or Habitude) of these Two Numbers: So if 5 and 7 are compared, their arithmetical Ratio is 2; and all Numbers that have the fame Difference, whatever they are themfelves, are in the same arithmetical Habitude to one another. By the Second Comparifon we find how oft or how many Times the Antecedent contains (if greatest) or is contained (if least) in the other; and this Number is called the geometrical Ratio (or Exponent of the geometrical Relation) of the Numbers compared;

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red; so compare 12 to 4, the Ratio is 3, signifying that 12 contains 4, or that 4 is con-

tained in 12, thrice.

THE geometrical Ratio thus conceived is always the Quote of the greater divided by the lesser: But observe when the lesser is antecedent to the greater, the Sense of the Comparis fon is also this, viz. To find what Part or Parts of the greater that lesser is equal to; and according to this Sense the geometrical Ratio of Two Numbers is made univerfally the Quote of the Antecedent divided by the Consequent, and is exprest by setting the Antecedent over the Consequent Fraction-wife; so that if the Antecedent is greatest, the Ratio is an improper Fraction, equal to some whole or mix'd Number, and fignifies that the Antecedent contains the Consequent as many Times, and Parts of a Time, as that Quote contains Units and Parts of an Unit. Example. The Ratio of 12 to 4 is equal to 3 (for 12 contains 4 thrice.) The Ratio of 18 to 7 is requal to 27, signifying that 18 contains 7 Two Times and ? Parts of a Time, i. e. ? Parts of 7; which is plainly this, that 18 contains Times 7, and 4 over. But if the Anteredent is least, the Ratio is a proper Fraction, signifying that the Antecedent is such a Part of the Consequent; so the Ratio of 7 to 9 is 2, i. e. that 7 is? Parts of 9.

In what follows I shall take the geometrical Ratio of Numbers both ways, as it happens to

be most convenient.

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II. An Equality of Ratios constitutes Proportion, which is arithmetical or geometrical as the Ratio is. A Ratio exists betwixt Two Terms, but Proportion requires at least Three; so these 1, 2, 3, are in arithmetical Proportion, or these, 2, 5, 8, because there is the same Difference betwixt the Numbers compared, which are 1 to 2, and 2 to 3, or 2 to 5, and 5 to 8. Again these are in geometrical Proportion, 2, 4, 8, or 9, 3, 1, because as 2 is a Half of 4, so is 4 of 8, also as 9 is triple of 3 so is 3 of 1.

OBSERVE, 1mo. In all Proportion, as there are at least Two Couple of Terms, so the Comparison must run alike in both, i. e. if it is from the lesser to the greater, or contrary, in the one Couple, it must be so in the other also; thus in 2, 6, 9 the Proportion runs, as 2 to 6 so is 6

to 9, or as 9 to 6 fo 6 to 2.

2do. It three proportional Numbers are right disposed, it will always be, as the 1st to the 2d, so the 2d to 3d, as above; but 4 Numbers are in Proportion when the 1st is to the 2d as the 3d to the 4th, without considering the Ratio of the 2d and 3d; as here 2:4:3:6; for in a proper Sense Proportion is the Equality of the Ratios of Two or more Couples of Numbers, whether they have any common Term or not; and so, strictly, there must be Four Terms to make Proportion, the there need be but Three different Numbers.

III. From the last Thing explained we have a Distinction of continued and interrupted Pro-

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portion Continued Proportion is when in a Series of Numbers there is the same Ratio of every Term to the next, as of the 1st to the 2d; as here 1:2:3:4:5, which is arithmetical and 1, 2, 4, 8, 16, which is geometrical. Interrupted is when betwixt any Two Terms of the Series there is a different Ratio from that of the rest; as 2:5:6:9, arithmetical, where 2 is to 5 as 6:9 (i.e. differing by 3,) but not so 5 and 6, or 2, 4, 3, 6; geometrical, where 2 is to 4 as 3 to 6 (i.e. a Half,) but not so 4 to 3; and observe that of 4 Terms, if there is any Interruption of the Ratio it must be betwixt the 2d and 3d, else these 4 are not proportional.

IV. Out of these Two Proportions arises a Third Kind, which we call harmonical Proportion, thus constituted; of Three Numbers, if the 1st be to the 3d in geometrical Proportion, as the Difference of the 1st and 2d to the Difference of the 2d and 3d, these Three Numbers are in harmonical Proportion. Example.

2: 3: 6 are harmonical, because 2: 6::

1: 3 are geometrical. And Four Numbers are harmonical, when the 1st is to the 4th, as the Difference of the 1st and 2d to the Difference of the 3d and 4th, as here 24: 16: 12: 9 are harmonical, because 24: 9:: 8: 3 are geometrical.

AGAIN, of 4 or more Numbers, if every Three immediate Terms are harmonical, the Whole is a Series of continual harmonical Proportionals as 30: 20: 15: 12:10. or if every 4 immediately next are harmonical, 'tis also a continued of the series of the series

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Series but of another Species, as 3, 4, 6, 9

How this came by the Name of harmonical Proportion shall be shewn afterwards; and here I shall explain the fundamental Properties of this Kind, having sirst proposed as much of the Doctrine of arithmetical and geometrical Proportion as is necessary for the Explanation of the other.

§ 2. Of Arithmetical and Geometrical Proportion,

THEOREM I. If any Number is given as the First of a Series of Proportionals, and also the common Ratio, the Series may be continued thus: 1mo. In arithmetical Proportion by adding the Ratio (or common Difference) to the 1st Term given, and then to the Sum; and so on to every succeeding Sum; these several Sums are the Terms sought in an increafing Series, which may be continued in infinitum. But to make a decreafing Series, fubstract the Ratio from the First Term, and from every fucceeding. Remainder; the feveral Remainders are the Terms fought. But 'tis plain this Series has Limits, and cannot descend in infinitum, Example. Given 3 forthe ift Term of an increasing Series, and 2 the arithmetical Ratio, or common Difference; the Series is 3, f, 7, 9, Oc. Or, given 8 the ift Term,

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Series, it is 8, 5, 2, and can go no further in positive Numbers. 2do. In geometrical Proportion, by multiplying the given Term into the Ratio (which I take here for the Quote of the greater Term divided by the lesser) and that Product again by the Ratio, and so on every succeeding Product by the Ratio; the several Products make the Series sought increasing, but for a decreasing Series divide. Example. Given 2 the 1st Term, and 3 the Ratio for an increasing Series it is 2:6:18,54, 162 (cc. Or, given 24 the 1st Term and the Ratio 2, the decreasing Series is 24:12:6:3.15,6c. It is plain a geometrical Series may increase or decrease in infinitum in positive Numbers.

THEOREM II. If Three Numbers are in arithmetical or geometrical Proportion, the Sum of the Extremes in the first, and the Product in the second Case, is equal to double the middle Term in the 1st, and to the Square of the middle Term in the second Case. Example. 3:7:11 arithmetical, the Sum of the Extremes 3 and 11 is equal to twice 7, viz. 14. And in these, 4:6:9 geometrical, the Product of 4 and 9, viz. 36, is equal to the Square of

6, or 6 Times 6.

COROLLARY. Hence the Rule for finding a Mean proportional, either arithmetical or geometrical, betwixt Two given Numbers is very obvious, viz. Half the Sum of the Two given Numbers is an arithmetical Mean, and the Square Root of their Product is a geometrical Mean.

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THEOREM III. If Four Numbers are in Proportion arithmetical or geometrical, whether continued or interrupted, the Sum of the Extremes in the first Case, and Product in the 2d, is equal to the Sum of the middle Terms in the 1st and the Product in the 2d Case. Example. In these, 2:3:4:5 arithmetical, the Sum of 2 and 5 is equal to the Sum of 3 and 4; and these geometrical 2:5:4:10 the Product of 2 and 10 is equal to that of 5 and 4, viz, 20.

COROLLARY. If Four Numbers represented thus, a:b::c:d, are proportional either arithmetically or geometrically, comparing a to b and c to d; they will also be proportional taken inversely, thus, d:c:b:a, or alternately thus, a:c:b:d, or inversely and alternately thus, d:b::c:a. The reason is obvious, because in all these Forms the Extremes and the middle Terms are the same, whose Sums, if they are arithmetical, or Products if geometrical, being equal, is a Sign of their Proportionality by this Theorem.

THEOREM IV. In a Series of continued Proportionals, arithmetical or geometrical, the Two Extremes with the middle Term, of the Extremes with any Two middle Terms at equal Distance from them, are also proportional. Example. 2, 3, 4, 5, 6, 7, 8 arithmetical, here 2, 5, 8, are arithmetically proportional, also 2, 4, 6, 8, or 2; 3: 7: 8. Again in this geometrical Series, 2: 4: 8: 16: 32:

64: 128, these are geometrically proportional

2: 16, 128, or 2: 8, 32: 128.

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THEOREM V. If Two Numbers in any geometrical Ratio are added to, or substracted from other Two in the same Ratio (the less with the less and greater with the greater) the Sums or Differences are in the same Ratio. Example. 6:3::10:5 are proportional, the common Ratio being 2, and 6 added to 10 makes 16, as 3 to 5 makes 8, and 16 to 8 are in the same Ratio as 6 to 3 or 10 to 5; and again 16 being to 8 as 6 to 3, their Differences 10 and 5 are in the same Ratio.

THE Reverse of this Proposition is true, viz. That if to or from any Two Numbers be added or substracted other Two, then, if the Sums or Differences are in the same geometrical Ratio of the First Two, the Numbers added or sub-

stracted are in the same Ratio.

Corollary, If any Two given Numbers are equally multiplied or divided, i. e. multiplied or divided by the same Number, the Two Products or Quotes are in the same Ratio with the given Numbers, i. e. are proportional with them. Example. 3 and 5 multiplied each by 7 produce 21 and 35, and these are proportional 3:5, 21:35. Again 24 and 16, divided each by 8 quote 3 and 2 and these are proportional 24:16, 3:2.

It follows also that if every Term of any continued Series is equally multiplied or divided it is still a continued Series in the same Ra-

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THEOREM VI. If Two Numbers in any arithmetical Ratio be added to other Two in the same Ratio (the less to the less and greater to the greater) the Sums are in a double Ratio, i.e. their Difference is double that of the respective Parts added; so, if to these 3:5, you add these 7:9 the Sums are 10, 14 whose Difference 4 is double the Difference of 3:5 or 7:9. And if to this Sum you add other Two in the same Ratio, the Difference of the last Sum will be triple the Difference of the First Two, and so on.

OBSERVE. If Two Numbers in any arithmetical Ratio are substracted from other Two in the same Ratio (the less from the less, &c.) the arithmetical Ratio of the Remainders is o, so from 7:9 take 3:5 the Remainders are

4, 4.

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Corollary. If Two Numbers in any arithmetical Ratio be both multiplied by the same Number, the Difference of the Products shall contain the First Difference, as oft as the Multiplier contains Unity; so 3, 5 multiplied by 4 produce 12, 20, whose Difference 8 is equal to 4 Times 2 (the Difference of 3 and 5) and so if any continued arithmetical Series has each Term multiplied by the same Number, the Products will make a continued Series with a Difference containing the former Difference as oft as the Multiplier contains Unity. But it divided, the Difference of the Quotes will be such a Part of the First Difference as the Divisor denominates.

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THEOREM VII. If Two Numbers in any Ratio arithmetical or geometrical, be added to, or multiplied by other Two in any other Ratio of the same Kind (the lesser by the lesser, and the greater by the greater) the Sums in the one Case and Products in the other are in a Ratio which is the Sum or Product of the Ratios of the Numbers added, or multiplied: An Example will explain it, Let 2:4 and 3:9 be added in the Manner mentioned, the Sums are 5, 13, whose arithmetical Ratio or Difference is 8 the Sum of 2 and 6 the Differences of the Numbers given; or if they are multiplied, viz. 2 by 3, and 4 by 9, the Products 6 and 36 are in the geometrical Ratio of 6, equal to the Product of 2 and 3 the Ratios of the given Numbers.

THEOREM VIII. If any Two Numbers are multiplied by fame Number, and the Products taken for the Extremes of a Series, they will admit of as many middle Terms as the Multiplier contains Units less one; and the whole Series will be in the arithmetical Ratio of the First Numbers; so let 3 and 7 be multiplied by 4 the Products are 12 and 28 (in the same geometrical Ratio as 3 and 7 by Corollary to Theorem 3th) and their arithmetical Ratio or Difference 16, is 4 Times as great as that of 3 and 7, which is 4 (by Corol. to Theor. 6.) and therefore they are capable of 3 fuch middle Terms as that the common Difference of the whole Series shall be 4; the Series is 12: 16,

examples, 2, 4, 8, 16, the arithmetical

20:24:28. Corollary. Hence we have a Solution to this Problem.

PROBLEM I. To find an arithmetical Series, of a given Number of Terms, whose Extremes shall be in the geometrical Ratio, and the intermediate Terms in the arithmetical Ratio of Two given Numbers; the Rule is, Multiply the given Numbers by the Number of Terms less 1, and then fill up the middle Terms by the given Ratio. Example. Let 3 to 5 be given for the Ratio of the Extremes, and 10 for the Number of Terms; I multiply 3 and 5 by 9, which produces 27 and 45, and the Series is 27, 29, 31, 33, 35, 37, 39, 41, 43, 45.

LET us now compare the arithmetical and

geometrical Proportions together.

THEOREM IX. If there is a Series of Numbers in continued arithmetical. Proportion, then the geometrical Ratios of each Term to the next must necessarily differ; and from the least Extreme to the greatest, these Ratios still increase; but from the greatest they decrease, comparing always the leffer to the greater; but contrarily if we compare the greater to the lesser. increasing from ;, and consequently decreasing from 1. Again, if we take a continued geome-trical Series, the arithmetical Ratios or Differencesinere afe from the least Extreme to the greatest, and contrarily from the greatest to the least. Example. 1, 2, 4, 8, 16, the arithmetical Ratios are 1, 2, 4 8. COROL-

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COROLLARY. It is plain, that if an arithmetical Mean is put betwixt Two Numbers, the geometrical Ratios betwixt that middle Term and the Extremes are unequal; and that of the lesser Extreme to the middle Term is less than that of the same middle Term to the other Extreme. Example. 2, 4, 6 the two geometrical Ratios are \frac{1}{2} and \frac{1}{2} comparing the lesser Number to the greater; but it is contrary if we compare the greater to the lesser.

§ 3. Of Harmonical Proportion.

THEOREM X. If Three or Four Numbers in harmonical Proportion are multiplied or divided by any the same Number, the Products or Quotes will also be in harmonical Proportion; because as the Products or. Quotes made of the Extremes are in the same Ratio of the Extremes, so the Differences of the Products of the intermediate Terms, tho' they are greater or lesser than the Disserences of these Terms, yet they are proportionally so, being equally multiplied or divided. Example. If 6, 8, 12, which are harmonical, be divided by 2, the Quotes are 3, 4, 6, which are also harmonical; and reciprocally, fince 3, 4, 6, are harmonical, their Products by 2, viz. 6, 8, 12 are barmonical.

THEOREM.

THEOREM XI. If double the Product of any Two Numbers be divided by their Sum, the Quote is an harmonical Mean betwixt them. Example. Let 3 and 6 be given for the Extremes to find an harmonical Mean, their Product is 18, which doubled is 36; this divided by 9 (the Sum of 3 and 6) quotes 4, and these Three are in harmonical Proportion, viz. 3:4:6.

To them that have the least Knowledge of Algebra, the following Demonstration will be plain; suppose any Two Numbers a and b, and a the greater, let the harmonical Mean sought be x; from the Definition of harmonical Proportion, we have this true in geometrical Proportion, viz. a:b::a-x:x-b. And by Theorem 3d, ax-ab=ab-xb: Then, ax+bx=2ab;

and laftly, x= W. W. D.

THEOREM XII. Take any Two Numbers in Order, and call the one the First Term, and the other the Second; if you multiply them together, and divide the Product by the Number that remains, after the Second is substracted from double the First, the Quote is a Third in harmonical Proportion, to be taken in the same Order. Example, Take 3:4 their Product is 12, which being divided by 2 (the Remainder after 4 is taken from 6 the double of the First) the Quote is 6, the Third harmonical Term sought: Or reversely, take 6, 4, their Product is 24, which divided by 8 (the Difference of 4 and 12) quotes 3, the Third Term sought.

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DEMONSTRATION. Take a and b known Numbers, and a the greatest; let x be the Third Term fought, less than b; then, since these are harmonical, viz. a, b, x, thefe are geometrical, viz. a: x:: a-b: b-x (by Definition 4. of the Extremes and Means, we have ab-ax=axxb; and ab=2ax-xb. And lastly $x=\frac{ab}{2a-b}$ W. W. D. The Demonstration proceeds the same way when

a is supposed less than b_1 and α greater.

OBSERVE. When a is greater than b, then a can always be found because in the Divifor (2a-b) 2a is necessarily greater than b. But if a is less than b, it may happen that 2a shall be equal to or less than b, and in that Case x is impossible. Example. Take 3 and 6. if a 3d greater than 6 be required it cannot be found; for 2a, viz. twice 3, or 6, is equal to b or 6; and fo the Divisor is 0; or if 2a be greater than b, as here 3, 5, where twice 3 or 6 is greater than 5, then it is more impossible.

HENCE again observe, that from any given Number a Series of continued harmonical Proportionals (of the Ift Species, i. e. where every 3 immediate Terms are harmonical) may be found decreasing in infinitum but not increa-

fing.

LASTLY, observe this remarkable Difference of the Three Kinds of Proportionals, viz. That from any given Number we can raife by Theorem 1. a continued arithmetical Series increasing in infinitum; but not decreasing. The harmonical is decreasable but not increasable in infinitum by 112 ATREATISE CHAP.IV.

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(by Theorem 1.)

THEOREM XIII. Take any Three Numbers in Order, multiply the ist into the 3d, and divide the Product by the Number that remains after the middle or 2d is substracted from double the 1st; and that Quote shall be a 4th Term in harmonical Proportion to the Three given. Example. Take these Three, 9, 12, 16, a 4th

will be found by the Rule to be 24.

DEMONSTRATION. Let any Three given Numbers be a, b, c, and a less than b, let the Number sought be x greater than c, then by Definition 4th, it is a:x::b-a:x-c, and ax-ac=bx-ax, lastly $x=x^a$. The Demonstration is the same when a is greater than b, and x less then c. Observe here also that if b is equal to or greater than a, then there can be no a to or greater than a, then there can be no a to only happen when the Terms increase, a, a, a, when a is less than a, and a less than a, then there can be no a is less than a, and a less than a is less than a, and a less than a. See this a a when a is less than a, and a less than a is less than a, and a less than a is less than a, and a less than a is less than a. See this a a which a and a less than a is less than a which a and a less than a is less than a. See this a a when a is less than a which a and a less than a is less

THEOREM XIV. Take any Series of continued arithmetical Proportionals, and out of these may be made a Series of continued harmonical Proportionals of the first Species, where every Two Terms shall be in a reciprocal geometrical Proportion of the correspondent Terms of the arithmetical Series. The Rule is, Take the Two first Couplets of the arithmetick Series, set them down in a reverse Order, (as in the Operation below) multiply each of the 1st Couple by the greater of the 2d, and the lesser of the one by the lesser

lesser of the other; and set down the Products; then, take the next Couplet, and multiply each of the last Products by the greater of this Couplet; and also the least of these Products by the least of this Couplet, and set down these new Products: Repeat this Operation with every Couplet, and the last Line of Products is the Series sought. The following Example and Operation will make it plain.

Arithmetical Series.

2:3:4:5:6, &c.

3:2
4:3

12:8:6

5:4

60:40:0:24
6:5

360: 240: 180: 144: 120, &c. is reduced to Harmonical Series. this, 30,20, 15,

NOTE, After this Operation is finished, the Series found may be reduced by equal Division, if possible; so the Series found in this Example, is reduced to this, 30,20, 15, 12, 10.

THE Demonstration of this Rule is easily made, imo. If we take any Three Numbers in arithmetical Proportion, and multiply them according to the Rule, 'tis manifest the Products will be harmonical; for the Two Extremes of the Three arithmetical being multiplied by the same middle Term, their Products (which are the Extremes of the Three harmonical) are in the same geometrical Ratio; and then the Two Extremes being multiplied together, and the Product made the middle Term, it must be an harmonical Mean,

Mean, because the arithmetical Ratio of the Two Couplets being equal, and the ift Couplet being multiplied by the greater Extreme, and the other by the leffer Extreme, the Differences of the Products are increased in Proportion of these Multipliers (viz. the Extremes) consequent-In the Three Products are in harmonical Proportion, according to the Theorem. But the same being true of every Three Terms immediately next in the arithmetical Series thus multiplied; and it being also true by Theorem to. that the Terms of any harmonical Series being equally multiplied the Products are also barmonical, and in the same geometrical Ratio, it will be evident that working according to the Rule we must have an harmonical Series.

THE Reverse of this Theorem is also true; viz. that if you take a Series of continued Harmonicals of the 1st Species, and multiply them in the Manner prescribed in the Rule, there will come out a Series of Arithmeticals, whose every Two Terms shall be reciprocally in the geometrical Ratio of their correspondent Harmonicals. Example. Take 3, 4, 6, the Products according to the Rule are 24: 18: 12, or by Reduction 4:3:2, which are arithmetical; fee the Operation The Reafon is plain, for the Difference of the Two Couplets 3:4:6 4:3 and 6:4 being geometri-4:3 cally as the Extremes 3:6, 6:4 when the ift Couplet is multi-24: 10: 12 plied by the greater Extreme, and the other by the least, the

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COROLLARY. From the Demonstration of this Theorem it follows, that taking any Series of whatever Nature, another may be made out of it, whose every Two Terms shall be respectively in a reciprocal geometrical Proportion of their Correspondents in the given Series.

THEOREM XV. In a Series of continued Harmonicals of the 1st Species, any Term with any Two at equal Distance from it are in barmonical Proportion. Example. 10, 12, 15, 20, 30, 60; becaule every Three immediate Terms are harmonical, therefore these are so, to, 15, 30; and thefe, 12, 20, 60. The Reason is easily deduced from the last. But of Harmonicals of the 2d Species, (See Definition 4.) it will not always hold that any Two with any other Two at equal Distance are also barmonical; an Example will demonstrate this See here 3 4 6, 9, 18, 36, tho' every Four next other are harmonical, yet these are not so, 3:6:9:

THEOREM XVI. If there are Four Numbers disposed in Order, whereof one Extreme and the Two middle Terms are in arithmetical Proportion, and the fame middle Terms with the other Extreme are in harmonical Proportion, the Four are in geometrical Proportion, as here, 2:3:4:6, which are geometrical, and whereof 2: 3: 4 are arithmetical, and 3, 4, 6 harmonical.

tor to the time this graphersthere ten

DEMONSTRATION. This Theorem contains 4 Cases. 1mo. If the First Three Terms are arithmetical increasing, and the last Three harmonical, the Four together are geometrical. Demonstration. Let a: b: c: d be Three Numbers, whereof a, b, c are arithmetical increafing from a, and b, c, d harmonical; then are a, b, c, d, geometrical; for fince out of the Harmonicals we have this geometrical Proportion, viz. b:d:c-b:d-c and also b-a=c-b (fince a, b, c are arithmetical) therefore b: d: b-a: d-c; and confequently (by Theor. 5.) b:d::a; c, or a: b: : c: d-W. W. D. Example. 2, 3, 4, 6. 2do. If the First Three are harmonical decreafing, and the last Three arithmetical, the Four are geometrical; this is but the Reverse of the last Case, and needs no other Proof. 3tio. If the First Three are arithmetical decreasing, and the other Three harmonical, the Four are geometrical, suppose a, b, c are arithmetical decreasing, and b, c, d, harmonical, then a, b, c, d, are geometrical, for out of the Harmonicals we have this geometrical Proportion, viz. b : d b-c (=a-b): c-d, therefore b:d::a:c, and a:b::c:d. Example. 8:6::4:3. 4to. If the first Three are harmonical increasing, and the other Three arithmetical, the Four are geometrical; this is the Reverse of the last.

Four Numbers are geometrical, and the first Three arithmetical or harmonical, the other Three must be contrarily harmonical or arithmetical; for to the same Three Numbers there can be but

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one individual Fourth geometrical, and to the Two last of them but one individual Third arithmetical or harmonical, therefore the Obferve is true. On a bons a sound !

THEOREM XVII. If betwixt any Two Numbers you put an arithmetical Mean, and also an harmonical one the Four will be in geometrical Proportion. Example. Betwixt 2 and 6 an arithmetical Mean is 4, and an harmonical one is 3, and the Four are 2:3::4:6 geometrical; the Demonstration you'll find here: Let a and b be Two given Numbers, an arithmetical Mean by Theor. 2. is and an harmonical Mean by Theor. 11. $\frac{2ab}{a+b}$, and these Four are geometrical $a:\frac{a+b}{2}:\frac{2ab}{a+b}:b$, which is proven by the equal Products of the Extremes and Means. and a remain a is composed of a regard to the

Parts, or hery many Times took a Tack of § 4. The Arithmetick of Ratios geometrical, or of the Composition and Resolution of Ra-Motios to test front months view rollow a I we take the Engineering

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DY the preceeding Definitions, the Exponent D of the geometrical Relation of Two Numbers is a proper Fraction, when we compare the leffer to the greater, fignifying that the lesser is such a Part or Parts of the greater; so the Ratio of 2 to 3 is ; fignifying that 2 is Two thirds of 3. Or, if we compare the greater to the lesser, it is an improper Fraction, which being reduced to its equivalent Whole H 3.

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or mix'd Number, expresses how many Times and Parts of a Time the greater contains the lesser; so the Ratio of 13 to 5 is; or 2, for 13 is equal to 2 Times 5, and 3 over: Or being kept in the stractional Form signifies that the greater is equal to so many Times such a Part of the lesser as that lesser denominates; and this Difference of comparing the greater as Antecedent to the lesser, or the lesser to the greater, constitutes Two different Species of Ratios.

ONE Number is faid to be composed of others, when it is equal to the Sum of these others; the Compound therefore must be greater than any of these of which it is composed; and this is the proper Sense of Composition of Numbers, fo 9 is composed of 4 and 5, or 6 and 3, &c. also \(\frac{1}{2} \) is composed of, or equal to the Sum of 2 and 5. But the Ratios are Fractions proper or improper, as they express what Part or Parts, or how many Times fuch a Part of one Number another Number is equal to ; yet in the Arithmetick proposed they are taken in a Notion very different from that of mere Numbers; for if we take the Exponents of Two Relations as Numbers, and add them together, the Sum is a Number compounded of the Numbers added, but it is not a Ratio or the Exponent of a Relation compounded of the other Two Ratios; so that Composition and Resolution of Ratios is not adding and subfracting them as Numbers. What it is fee in the following Definition, wherein I take the Ratio or Exponent of the Relation of Two Num

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10, nDEFINITION. One Ratio is faid to be compounded of others, when it is equal to the Ratio betwixt the continual Product of the Antecedents of these others, and the continual Product of their Consequents multiplied as Numbers (i.e. by the Rules of common Arithmetick) or thus, one Ratio is compounded of others, when, as a Number, it is equal to the continual Product of these others considered also as Numbers. Example. The Ratio of 1 to 2 is compounded of the Ratios of 2 to 3, and 3 to 4, because is equal to 3 multiplied by is also 40 to 147 is in the compound Ratio of these, viz. 21 3, 5: 7 and 4: 7.

THEOREM XVIII. Take any Series whatever, the Ratio of the First Term to the last considered as a Number, is equal to the continual Product of all the intermediate Ratios multiplied as Numbers, taking every Term in Order from the First as an Antecedent to the next. For Example. In this Series 3, 4, 5, 6, the Ratio of 3 and 6 is \frac{1}{2}, equal to the continual Product of these \frac{3}{4}, \frac{1}{5}, \frac{1}{6}, for when all the Numerators are multiplied together, and all the Denominators, it is plain the Products are as 3 to 6, because all the other Multipliers are common to both Products; and it must be true in every Series for the same Reason.

geometrical Proportion, the Ratio of the Extremes is equal to the common Ratio taken and

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multiplied into it felf, as a Number, as oft as there are Terms in the Series less one.

PROBLEM II. To find a Series of Numbers which shall be to one another (comparing them in Order each to the next) in any given Ratios, taken in any Order affigned. RULE. Multiply both Terms of the Ift Ratio by the Antecedent of the 2d, and the Consequent of this by the Consequent of the ist; and thus you have the ift Two Ratios reduced to Three Terms, which multiply by the Antecedent of the 3d Ratio, and the Consequent of this by the last of these Three, and you have the ist Three Ratios reduced to 4 Terms: Go on thus, multiplying the last Series by the Antecedent of the next Ratio, and the Consequent of this by the last Term of that last Series. Justness of the Rule appears from this, That the Terms of each Ratio are equally multiplied. Example. The Ratios of 2:3, of 4:5 and 6: 7 are reduced to this Series 48:72:90:105. See the Operation.

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| 8. 1,2. 15 |
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| 48:72:90:105 |
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OBSERVE. From the Operation of this Rule it is plain, that the Extremes of the Series found are, the One equal to the continual Product of all the Antecedents, and the other to the continual Product of all the Consequents of the given

Ratios; fo that these Extremes are in the compound Ratio of the given Ones; which is otherwife

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wife plain from the last Proposition, since all the intermediate Terms of this Series are in the Ratios given respectively. And it follows also, that where any Number of Ratios are reduced to a Series, tho' the Number of the Series will differ according to the different Orders, yet because the intermediate Ratios are the same in every Order, the Extremes must still be inthe same Ratio.

THEOREM XIX. Every Ratio is composed of an indefinite Number of other Ratios; for, by Corol. to Theor. 5. if any Two Numbers are equally multiplied, the Products are in the fame geometrical Ratio, and by Corol. to Theor. 6. their Difference contains the First Difference, as oft as the Multiplier contains Unity; therefore it is plain that these Products are the Extremes of a Series, which can have as many middle Terms as their Difference has Units less one; and consequently by taking the Multiplier greater you make the Difference of the Products greater, which admitting still a greater Number of middle Terms, reduces the Ratia given into more intermediate Ones: So take the Ratio of 2: 3, multiply both Terms by 4, the Products are 8: 12, and the Series is 8:90 10:11:12, but multiply by 7, the Series is 14:15:16:17: niv cach Consequent into all its: 02: 21: 81

OBSERVE. We may fill up the middle Terms very differently, fo as to make many different Series betwixt the same Extremes: And hereby we learn how to take a View of all the quent, and each An what into all the Cente-

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mean Ratios, of which any other is compofed.

THEOREM XX. The geometrical Ratio of any Two Numbers taken as a proper Fraction, (i.e. making the leffer Number the Antecedent) is less than that of any other Two Numbers which are themselves respectively greater, and yet have the same arithmetical Ratio or Difference. Example. The Ratio 2:3 taken as a Fraction is \(\frac{2}{3} \) less than that of 3:4, viz. \(\frac{2}{3} \), or than 5:6, viz. \(\frac{2}{3} \).

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DEMONSTRATION. Let a and a to be represent any Two Numbers, let a to and a to be represent other Two which are respectively greater than the first Two, but have the same Difference b; take them Fraction-wise thus, and are to one common Denominator, the new Numerators will be found an tackat than the other by be; therefore the First Fraction, to which the Numerator

an Fac Fab corresponds, is least.

PROBLEM III. To reduce any Number of Ratios to one common Antecedent or Confequent. Rule. Multiply all their Antecedents continually into one another, that Product is the common Antecedent fought: Then multiply each Confequent into all the Antecedents (except its own) continually, and the last Product is the Confequent correspondent to the Confequent that was now multiplied. Or, multiply all the Confequents for a common Confequent, and each Antecedent into all the Confequents (except its own) for a new Antecedent. So these

thele Ratios, 2: 3, 3: 4, 4: 5 reduced to one Antecedent, are 24: 36, 24: 32, 24: 30, which in one Series are 24: 36: 32: 30.

THE Reason of the Rule is plain from this; that the Terms of each Ratio are equally mul-

tiplied.

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ADDITION of RATIOS.

PROBLEM IV. To add one or more Ratios together, or to find the Compound of these Ratios. RULE. Multiply all the Antecedents continually into one another, and all the Confequents; the Two Products contain the Ratio fought; which is plainly this; Takethe Ratios Fraction-wife, (the Antecedent of each, whether tis greater or lesser than the Consequent, being the Numerator, and the Consequent the Denominator) and as fractional Numbers multiply them continually into another, the last Product is the Exponent of the Relation fought. Example. Add the Ratios of 2:3, 5:7 and 8:9, the Sum or compound Ratio fought is 80:189. The Reason of the Rule is plain from the Definition of a compound Ratio in § 4 of this Chap ter.

OFSERVE IMO. To understand in what Sense this Operation is called Addition of Ratios, we must consider that to compound Two or more Ratios is in effect this, viz. to find the Extremes of a Series whose intermediate Terms are respectively in the Ratios given; so to compound or add the Ratios, 2:3 and 4:5.

is to find the Extremes of Three Numbers, whereof the 1st shall be to the 2d as 2 to 3, and the 2d to the 3d as 4 to 5. Such a Series may in any Case be found by Probl. 2. and in this Example it is 8: 12:15, for 8 is to 12 as 2 to 3, and 12:15 as 4:5, and 8:15 is the compound Ratio sought, which is called the Sum of the given Ratios, because it is the Effect of taking to the Consequent of the 1st Ratio, considered now as an Antecedent, a new Consequent in the 2d Ratio; and so of more Ratios added.

whether all the Ratios to be added are of one Species or not, i. e. whether all the Antecedents are greater than their Confequents, or all less, or some greater some less. For in this Rank 3: 4:5:2 the Ratio of 3 to 2 is compounded of the intermediate Ratios 3:4, 4:5, and 5:2: tho' the last is of a different Species from the other Two; what Difference there is in the Application to musical Intervals shall be explained in its Place.

SUBSTRACTION of RATIOS:

PROBLEM V. To substract one Ratio from another. Rule. Multiply the Antecedent of the Substrahend into the Consequent of the Substractor, that Product is Antecedent of the Remainder sought; then multiply the Antecedent of the Substractor into the Consequent of the Substrahend, and that Product is the Consequent of

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THE Reason of this Rule is plain; for, as the Sense of Substraction is opposite to Addition, fo must the Operation be; and to substract one Ratio from another signifies the finding a Ratio, which being added (in the fense of Probl. 4.) to the Substracter, or Ratio to be substracted, the Compound or Sum shall be equal to the Substrahend; and therefore, as Addition is done by multiplying the Ratios as Fractions, fo must Substraction be done by dividing them as Fractions; and so in this Series 6:9:10, the Ratio 6: 10 (or 3:5) is composed of 6:9 (or 2:3) and 9: 10; which Composition is done by multiplying 2 into 3 whose Product is 18 or 1 : So to substract 6:9 or 2:3 from 6:10 or 3: 5, it must be done by a reverse Operation dividing : by : whose Quotient is 2.

OBSERVE. As in Addition, the Ratios added may be of the same or different Species, so it may be in Substraction; but it is to be observed here that the Two given Ratios to be substracted, being considered as Fractions, and both proper Fractions, then, the least being substracted from the greater, the Remainder is a Ratio of a different Species, as in this Series, 5: 3:7, for take? from? the Remainder is : But take

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is to find the Extremes of Three Numbers, whereof the 1st shall be to the 2d as 2 to 3, and the 2d to the 3d as 4 to 5. Such a Series may in any Case be found by Probl. 2. and in this Example it is 8: 12:15, for 8 is to 12 as 2 to 3, and 12:15 as 4:5, and 8:15 is the compound Ratio sought, which is called the Sum of the given Ratios, because it is the Effect of taking to the Consequent of the 1st Ratio, considered now as an Antecedent, a new Consequent in the 2d Ratio; and so of more Ratios added.

whether all the Ratios to be added are of one Species or not, i. e. whether all the Antecedents are greater than their Confequents, or all less, or some greater some less. For in this Rank 3: 4:5:2 the Ratio of 3 to 2 is compounded of the intermediate Ratios 3:4, 4:5, and 5:2: tho' the last is of a different Species from the other Two; what Difference there is in the Application to musical Intervals shall be explained in its Place.

SUBSTRACTION of RATIOS:

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of the Remainder fought; which is plainly this; Take the Two Ratios Fraction-wife, and divide the one by the other according to the Rules of Fractions. Example. To substract the Ratio of 2:3 from that of 3:5; the Remainder is 9:10, for \(\frac{2}{5} \) divided by \(\frac{2}{5} \) quotes

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OBSERVE. As in Addition, the Ratios added may be of the same or different Species, so it may be in Substraction; but it is to be observed here that the Two given Ratios to be substracted, being considered as Fractions, and both proper Fractions, then, the least being substracted from the greater, the Remainder is a Ratio of a different Species, as in this Series, 5: 3: 7, for take? from? the Remainder is !: But take

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the greater from the lesser, and the Remainder is of the same Species; so; from; there remains; as in this Series 2:5:7. Again suppose both the given Ratios are improper Fractions (i. e. the Antecedents greater than the Consequents) if the least is substracted from the greater, the Remainder is of the same Species; but the greater from the lesser and the Remainder is of a different Species. Example.; from remains; as in this Series 7:5:2. But; from remains; as in this Series 7:5:2. But; from remains; as here 7:2:5; these Observations are all plain from the Rule.

MULTIPLICATION of RATIOS.

PROBLEM VI. To multiply any Ratio by a Number. This Problem has Two Cales.

Number. Rule. Take the given Ratio as oft as the Multiplier contains Unity, and add them all by Probl. 4th. Example. 2:3 multiplied by 4, produces 16:81; or thus, Take the Ratio as a Fraction, and raise it to such a Power as the Multiplier expones, that is, to the Square if it is 2, to the Cube if 3, and so on.

For the Reason of the Rule consider, That as the multiplying any Number signifies the adding it to it self, or taking it so many Times as the Multiplier contains Unity, so to multiply any Ratio signifies the adding or compounding it with it self, so many Times as the Multiplier contains Unity, i.e. to find a new Ratio that shall be equal to the given one so of compound-

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ed, thus, to multiply the Ratio of 2:3 by the Number 4 signifies the finding a Ratio equal to the compound Ratio of 2:3 taken 4 Times, which is 16:81; for 2:3, 2:3, 2:3, being added by Probl. 4. amount to 16:81, and

to fill up the Series apply Probl. 2.

of the same Species with the given Ratio; as is plain from the Rule. And if you'll complete the Series by Probl. 2. i. e. turn the given Ratio so oft taken as the Multiplier expresses into a Series, it will be a continued geometrical one. Thus, 2, 3 multiplied by 4, produces 16, 81, and the Series is 16: 24: 36: 54: 81; and this Series shows clearly the Import of this Multiplication, that it is the finding the Extremes of a Series, whose intermediate Terms have a common Ratio equal to the given Ratio, and which contains that Ratio as oft repeated as the Multiplier contains 1.

Fraction, that is, to take any Part of a given Ratio. Rule. Multiply it by the Numerator of the Fraction, according to the last Case, and divide that Product which is also a Ratio by the Denominator, after the Method of Case 1. of the following Probl. the Quote is the Ratio sought. Example. To multiply the Ratio 8:27, by First, I multiply 8:27 by 2, the Product is 64:729, and this divided by 3, according to the next Probl. quotes the Ratio 4:9, so that the Ratio 4:9

is ? Parts of the Ratio 8: 27.

THE Reason of the Operation is this, fince 3 Parts of 1 (i.e. of once the Ratio to be multiplied) is equal to ? Part of 2 (or of twice the Ratio to be multiplied) therefore having taken that Ratio twice, I must take a Third of that Product, to have the true Product fought: And fo of other Cases. The Sense of this Case will appear plain in this Series 8:12:18:27 which is in continued geometrical Proportion, the common Ratio being that of 2:3; consequently 8:27: contains 2:3 Three Times; or 2:3 multiplied by 3 produces 8: 27: Also 8: 18 (equal to 4: 9) contains 2:3 twice, and confequently is equal to ? Parts of 8: 27.

OBSERVE. It produces the same Thing to divide the given Ratio by the Denominator of the given Fraction, and multiply the Quote (which is a Ratio) by the Numerator; because,

for Example, 2 Times ; of a Thing is equal to; of twice that Thing.

COROLLARY. To multiply a Ratio by a mix'd Number, we must multiply it separately, First, By the integral Part (by Case 1.) and then by the fractional Part (by Case 2.) and sum these Products (by Probl. 4.) or reduce the mix'd Number to an improper Fraction, and apply the Rule of the last Case. Example. To multiply 4:9 by 1; or 3, the Product is 8:27, for in this Series 8: 12: 18: 27, it is plain 6: 27 is 3 Times 2: 2. And this is - of 4:9 (equal to 8:18) confequently 8:27 is equal to Halfs or 1 and - of 4:9.



DIVISION of RATIOS.

PROBLEM VII. To divide any Ratio by a

Number. This Probl. has Three Cafes.

CASE I. To divide any Ratio by a whole Number, that is, to find such a Ratio as being multiplied (or compounded into it self) as oft as the Divisor contains Unity, shall produce the given Ratio, Rule. Out of the Ratio, taken as a Fraction, extract such a Root as the Divisor is the Index of, i. e. the square Root if the Divisor is 2, the cube Root if the Divisor is 3, Oc. and that Root is the Exponent of the Relation sought. Example. To divide the Ratio of 9: 16 by 2, the square Root

of 2 is 3 which is the Ratio fought.

THE Reason of this Rule is obvious, from its being opposite to the like Case in Mu tiplication; and is plain in this Series, 9: 12: 16, which in the continued Ratio of 3: 4. and since the multiplying 3: 4 by 2, to produce 9: 16, is performed by multiplying \frac{1}{2} by \frac{1}{2}, or squaring \frac{1}{2}, the Division of 9: 16 by 2 to find 3: 4, can be done no other ways than by extracting the square Root of \frac{1}{2}, which is \frac{1}{2}; and so of the Cases; which will be all very plain to them who understand any Thing of the Nature of lowers and Roots. Or solve the Probl. thus; and the first of as many geometrical Means bewixt the Terms of the given Ratio as the Divisor contains of Units less one, that compared with the lesser Term of the given Ratio contains

tains the Ratio fought; thus 9: 12 is the

Answer of the preceeding Example.

CASE II. To divide a Ratio by a Fraction, that is, to find a Ratio of which fuch a Part or Parts as the given Fraction expresses shall be equal to the given Ratio. Rule. Multiply it by the Denominator (by Probl. 6. 1 Case) and divide the Product by the Numerator (by Case 1 of this Probl.) the Quote is the Ratio sought. Or divide the Ratio by the Numerator, and multiply the Quote by the Denominator. Example. To divide 4:9 by $\frac{2}{3}$ or to find $\frac{2}{3}$ Parts of 4:9, I take the Cube of $\frac{4}{9}$, it is $\frac{64}{729}$, whose square Root is $\frac{2}{37}$ the Ratio sought. The Reason of the Operation is contained in this, that it is opposite to Case 2. of Multiplication. And because 8:27 multiplied by $\frac{2}{3}$, produces 4:9, so 4:9 divided by $\frac{2}{3}$ ought to quote 8:27.

COROLLARY. To divide a Ratio by a mix'd Number; reduce the mix'd Number to an improper Fraction, and divide as in the last

Cafe.

CASE III. To divide one Ratio by another, both being of one Species; that is, to find how oft the one is contained in the other; or how oft the one ought to be added to it felf to make a Ratio equal to the other. Rull. Substract the Divisor from the Dividend (by Probl. 5.) and the same Divisor again from the last Remainder; and so on continually, till the Remainder be a Ratio of Equality; and then the Number of Substractions is the Number

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Number fought; or, till the Species of the Ratio change, and then the Number of Substractions less one is the Number of Times the whole Divisor is found in the Dividend, and the last Remainder except one is what the Dividend contains over fo many Times the Divisor. Example. To divide the Ratio 16:81 by 2:3, I substract 2: 3 from 16:81, the Remainder is 48: 162 equal to 8: 27; from this I tebstract 2:3, the 2d Remainder is 24:54, equal to 4:9; from this I substract 2:3, the 3d Remainder is 12: 18 or 2:3; from this I substract 2:2, the 4th Remainder is 6: 6 or 1: 1, a Ratio of Equality; therefore the Quote fought is the Number 4, fignifying that the Ratio 2: 3 taken 4 Times, is equal to 16: 54; as you fee it all in this Series 16:24:36:54:81. Example 2. To divide 12:81 by 2:3, proceed in the same Manner as before, and you'll find the Remainders to be 2:9, 1:3, 1:2, 3:4, 9:8, and because the last changes the Species, I justly conclude that the Ratio 12:81 does not contain 2:3 five Times, but it contains it 4 Times and 3:4 over; for 2:3 multiplied by 4 produces 16:81, which added to 3:4 makes exactly 12:81, as in this Series 16:24:36: 54: 84:108 whose Extremes 16:108, (equal to 12:81) is in a Ratio compounded of 16:81 and 81:108 (equal to 3.4.)

OBSERVE. The Two Ratios given must be of one Species; because the Sense of it is, to find how oft the Divisor must be added to it felf to make a Ratio equal to the Dividend;

and in multiplying, any Ratio by a whole Number, that Ratio and the Product are always of one Species, as was observed in Probl. 6. therefore 'tis plain that the Ratio of the Dividend, taken as a Fraction, must be lesser than the Divisor so taken, the Antecedent being least, i. e. thefe Fractions being proper, and contrarily if they are improper; the Reason is plain, because in an increasing Series, i. e. where all the Antecedents are lesser than their Confequents, the Ratio of the First to the least Extreme is less than the Ratio of any Two of the intermediate Terms, and yet, according to the Nature of Ratios, contains them all in it; but in a decreasing Series, i. e. where all the Antecedents are greater than the Consequents, the ist to the least, or the greatest Antecedent to the least Consequent, is in a greater Ratio than any of the intermediate, and also contains them all: So in this Series 2:3:4:5, the Ratio 2: 5 contains all the intermediate Ratios, and yet; is less than; or; or; but take the Series reverfely, then ; is greater than ; or + or = 100 es fars er of Landon He 14/

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55. Containing an Application of the preceding Theory of Proportion to the INTERVALS of Sound.

Thas been already shewn that the Degrees of Tune are proportional to the Numbers of Vibrations of the sonorous Eody in a given Time, or their Velocity of Courses and Recourses; which being proportional, in Chords, to their Lengths (cateris paribus) we have the just Measures of the relative Degrees of Tune in the Ratios of these Lengths; the grave Sound being to the acute as the greater Length to the lesser.

The Differences of Tune make Distance or Intervals in Musick, which are greater and leffer as these Differences are, whose Quantity is the true Object of the mathematical Part of Musick. Now these Intervals are measured, not in the simple Differences, or arithmetick Ratios of the Numbers expressing the Lengths or Vibrations of Chords, but in their geometrical Ratios; so that the same Difference of Tune, i. e. the same Interval depends upon the same geometrical Ratio; and different Quantities or Intervals arise from a Difference of the geometrical Ratios of the Numbers expressing the Extremes, as has been already shewn; that is, equal

equal geometrical Ratios betwixt whatever Numbers, constitute equal Intervals, but unequal

Ratios make unequal Intervals.

Bur now observe, that in comparing the Quantity of Intervals, the Ratios expressing them must be all of one Species; otherwise this Absurdity will follow, that the same Two Sounds will make different Intervals; for Example, Suppose Two Chords in Length, as 4 and 5, its certainly the same Interval of Sound, whether you compare 4 to 5, or 5 to 4, yet the Ratios of 4:5 and 5:4 taken as Numbers, and express Fraction-wise would differ in Quantity, and therefore different Ratios cannot without this Qualification make in every Case different Intervals.

In what Manner the Inequality of Intervals are measured, shall be explained immediately; and here take this general Character from the Things explained, to know which of Two or more Intervals proposed are greatest. If all the Ratios are taken as proper Fractions, the least Fraction is the greatest Interval. But to see the Reason of this, take it thus; The Ratios that express several Intervals being all of one Species, reduce them(by Probl. 3. of this Chap.) to one common Antecedent, which being lesser than the Consequents, that Ratio which has the greatest Consequent is the greatest Interval. The Reason is obvious, for the longest Chord gives the gravest Sound, and therefore must be at greatest Distance from the common acute Sound, Or contrarily, reduce them to one common Confequent greater than the Antecedents

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dents, and the lesser Antecedent expresses the acuter Sound, and consequently makes with that common fundamental or gravest Sound, the

greater Interval.

Ix follows that if any Series of Numbers are in continual arithmetical Proportion, comparing each Term to the next, they express a Series of Intervals differing in Quantity from first to last; the greatest Interval being betwixt the Two least Numbers, and so gradually to the greatest, as here 1 : 2 : 3 : 4. 1 : 2 is a greater Interval than 2:3, as this is greater than 3: 4. The Reason why it must hold so in every Cafe is contained in Theor. 20. where it was demonstrated that the geometrical Ratio of any Two Numbers taken as a proper Fraction (i. e. making the lesser the Antecedent) is less than that of any other Two Numbers, which are themselves respectively greater, and yet have the same arithmetical Ratio or Difference: And by what has been explained we fee that the lesser proper Fraction makes the greater Interval.

Thus we can judge which of any Intervals proposed is greatest, and which least, in general; but hew to measure their several Differences or Inequalities is another Question; that whose Extremes make the least Fraction is the greatest Interval, and so, in general, the Quantities of several Intervals are reciprocally as these Fractions; but this is not always in a simple Proportion. For Example, The Interval 1:2, is to the Interval 1:4 exactly as \frac{1}{2} to \frac{1}{2} (or as 1 to 2) the Quantity of the last being double the other.

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But 2: 3 to 4: 9 is not as \(\frac{4}{9} \) to \(\frac{7}{3} \), but as 1 to 2, as shall be explained. Sounds themselves are expressed by Numbers, and their Intervals are represented by the Ratios of these Numbers, so these Intervals are compared together by comparing these Ratios, not as Numbers, but as Ratios; and I suppose every given Interval is expressed by expressing distinctly the Two Extremes, i. e. their relative Numbers.

I shall now explain the Composition and Re-Jolution of Intervals, which is the Application of the preceding Arithmetick of Ratios; and this I shall do, First in general, without Regard to the Difference of Concord and Discord, which shall imploy the rest of this Chapter; and in the next make Application to the various Relations and Compositions of Concords;

and after that of Discords in their Place.

In what Sense Ratios are said to be added and substracted, &c. has been explained, but in the Composition of Intervals we have a more proper Application of the true Sense of adding and substracting, &c. The Notions of Addition and Substraction,&c. belong to Quantity; concerning which it is an Axiom, that the Sum, or what is the Result of Addition, must be a Quantity greater than any of the Quantities added, because it is equal to them all: And in substracting we take a lesser Quantity from a greater, and the Remainder is less than that greater, which is equal to the Sum of the Thing taken away and the Remainder. A mere Relation cannot properly be called Quantity

Quantity, and therefore the geometrical Ratio of Numbers can be no otherwise called Quantity than as by taking the Antecedent and Consequent Fraction-wise, they express what Part or how many Times fuch a Part of the Consequent the Antecedent is equal to; and then the greater Fraction is always the greater Ratio. But the Composition of Ratios is a Thing of a quite different Sense from the Composition of mere Numbers or Quantity; for in Quantities, Two or more added make a Total greater than any of them that are anded; but in the Composition of Ratios, the Compound considered as a Number in the Sense abovementioned, may be less than any of the component Parts. Now we apply the Idea of Distance to the Difference of Sound in Acutenefs and Gravity in a very plain and intelligible Manner. fo that we have one universal Character to determine the greater or lesser of any Intervals proposed; according to which Notion of Greatness and Littleness all Intervals are added and fubstracted, Gc. and the Sum is the true and proper Compound of feveral lesser Quantities; and in Substraction we actually take a lesser Quantity from a greater; but the Intervals themselves being expressed by the geometrical Ratio of Numbers applied to the Lengths of Chords (or their proportional Vibrations) the Addition and Substraction, &c. of the Quantities of Intervals is performed by Application of the preceeding Arithmetick of Ratios.

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Note. In the following Problems I constantly apply the Numbers to the Lengths of Chords, and so the lesser of Two Numbers that express any Interval I call the acute Term and the other the grave.

ADDITION of INTERVALS.

PROBLEM VIII. To add Two or more Intervals together. RULE. Mutiply all the acute Terms continually, the Product is the acute Term fought; and the Product of the grave Terms continually multiplied, is the grave Term fought; that is, Take the Ratios as proper Fractions; and add them by Probl. 4. Example. Add a 5th 2:3 and, a 4th 3:4, and a 3d g. 4:5, the Sum is 24:60 equal to 2:5.

a 3d g. above an Octave.

OBSERVE. This is a plain Application of the RULE for adding of Ratios, and to make it better understood, suppose any given Sound reprefented by a, and another Sound, acuter or graver in any Ratio, represented by b; if again we take a Third Sound still acuter or graver than b, and call it c, then the Sound of c being at greater Distance from a, towards Acuteness or Gravity, than b is, the Interval betwixt a and c is equal to the other Two betwixt a b and b c. And fo let any Number of Intervals be proposed to be added, we are to conceive some Sound a as one Extreme of the Interval fought; to this we take another Sound b acuter or graver in any given Ratio; then a Third Sound c acuter or graver than b in an

another given Ratio, and a 4th Sound d acuter or graver than c, and so on; every Sound always exceeding another in Acuteness or Gravity, and all of them taken the same way, i. e. all acuter, or all graver than the preceeding, and consequently than the first Sound a; and then the first and last are at a Distance equal to the Sum of the intermediate Distances. For Example. If 5 Sounds are represented by a, b, c, d, e exceeding each other by certain Ratios of Acuteness or Gravity from a to e, the Interval a: e is equal to the Sum of the Intervals a:

b, b : c, c : d, d : e.

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Now that the Rule for finding the true Disance of a:e is just, you'll easily perceive by considering that Intervals are represented by Ratios: therefore feveral Intervals are added by compounding the Ratios that express them; for if the given Intervals or Ratios are reduced, by Probl. 2. to a Series continually increasing or decreasing, wherein every Number being antecedent to the next, they shall contain in Order the Ratios given, i. e. express the given Intervals, 'tis plain the Ratio of the Extremes of this Series shall be composed of all the intermediate (which are the given) Ratios, and therefore be the Sum of them according to the true Sense in which Intervals are added, as it has been explained; fo in the preceeding Example, in which we have added a 5th 2:3, a 4th 3:4 and a 3d g. 4:5, the Compound of these Ratios is 24:60 or 2: 5; for take them in the Order proposed they

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are contained in this simple Series, 2:3:4:5, which represents a Series of Sounds gradually exceeding each other in *Gravity* from 2 to 5 by the intermediate Degrees or *Ratios* proposed; so that 2:5 being the true Sum of these *Intervals*, and the true *Compound* of the given *Ratios*, shews the *Rule* to be just.

AGAIN take Notice, that the' in the Composition of Ratios it is the same Thing whether they are all of one Species or not, yet in their Application to Intervals they must be of one Kind. I have already shewn what Absurdity would follow if it were otherwise, but you may fee more of it here; suppose Three Sounds represented by 4: 5: 3, tho' 4:3 is the true Compound of these Ratios 4: 5 and 5: 3, yet it cannot express the Sum of the Intervals reprefented by these; for if 4 represent one Extreme and 5 the middle Sound (graver than the former) 3 cannot possibly represent another Sound at a greater Distance towards Gravity, because 'tis acuter than 5, and therefore instead of adding to the Distance from 4, it diminishes it; but it is the same Interval (tho' in some Sense not the same Ratio) whether the leffer or greater is antecedent; and the Sum of these Two Intervals cannot be represented but by the Extremes of a Series continually increasing or decreasing from the least or greatest of the Numbers proposed, because they cannot otherwise represent a Series of Sounds continually rifing or falling, the Ratio of the Extremes of which Kind of Series can only be cal

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called the Sum of the intermediate Distances or ntervalof Sound; and so the preceeding Example must be taken thus, 3:4:5, where 3:5 is not only the compound Ratio of 3:4 and 4:5, but expresses the true Sum of the Inter-

vals represented by these Ratios.

It is plain then from this Explication, that in Addition of Intervals the Sum is a greater Quantity than any of the Parts added, as it ought to be, according to the just Notion of the Quantity of Intervals; but it would be otherwise and absurd if the Ratios expressing Intervals were not taken all one way; so in the preceeding Example tho 4:3 is the Compound of 4:5 and 5:3, yet considered as a Fraction it is greater than in and consequently a lesser Interval, by the Character already established.

PROBLEM IX. To add Two or more Intervals, and find all the intermediate Terms; a certain Order of their Succession being assigned, from the gravest or the acutest Extreme. Rule. If the given Intervals are to proceed in Order from the acutest Term, make the lesser Numbers Antecedents; if from the gravest, make the greater Antecedents, and then apply the Rule of Probl. 2.

EXAMPLE. To find a Series of Sounds, that from the acutest to the gravest shall be in Order (comparing the 1st to the 2d, and the 2d to the 3d, and so on) a 3d g: 4th: 3d l:5th. Working by the Rule I find this Series 120:150:

200

200:240:360, or reduced to lower Terms by Division they are 12:15:20:24:36. See the Operation here. But if the same Intervals are

to proceed in that Order from that Order from the gravest Extremes, the Series is 90:72:54:45:30.

60:75:100:120 2:3-5th.

120 : 150 : 200 : 240 : 360

OBSERVE. In adding feveral Intervals in a continued Series, the Sum or Ra-

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tio of the Extremes must always be the same, whatever Order they are taken in; because in any Order the Ratio of the Extremes is the true Compound of all the intermediate Ratios, or the Ratios added, which being individually the same, only in a different Order, the Sum must be the same; but then according to the different Orders the Series of Numbers will be different, so if we add a 4th 3:4, 3d gr.4:5

different, so if we add a 4th 3:4, 3d gr.4:5
and a 3d less. 5:6, they

3!4:5:6:8 ferent Orders, which are
5:6:8:10 contained in these Six
16:8:10:20 different Series, which
12:15:20:24 contain all the different
15:20:24:30 Orders both from Gracing and Acuteness.

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SUBSTRACTION of INTERVALS.

PROBLEM X. To substract a lesser Interval from a greater. Rule. Multiply the acute Terms of each of the given Intervals by the grave Term of the other, and the Two Products are in the Ratio of the Difference sought, that is, take the Ratios given as proper Fractions, and

substract them by Probl 5.

EXAMPLE. Substract a 5th 2:3 from an Octave 1:2, the Remainder or Difference is a 4th 3:4. See the Intervals in this Series (made by reducing both the Intervals given to a common Fundamental by Probl. 3) 6:4:3 the Extremes 6:3 are Octave, the intermediate Ratios are 6:4 a 5th, and 4:3 a 4th, therefore any one of them taken from Octave leaves the other.

THE Reason and Sense of the Rule is obvious; for as Substraction is opposite to Addition, so must the Operation be; and this is a plain Application of the Substraction of Ratios, with the same Limitation as in Addition, viz. that the Ratios must be taken both one way, so that we take always a lesser Quantity from a greater, and the Remainder is less than that greater, according to the true Character whereby the greater and less Intervals are distinguished.

OBSERVE. The Difference of any Two Intervals expresses the mutual Relation betwixt any Two of their similar Terms, i. e. Suppose any Two Intervals reduced to a common acute

or grave Term, their Difference is the Interval contained betwixt the other Two Terms; and the Ratio expressing it is called the mutual Relation of the Two given Intervals; so the Difference or mutual Relation of an Octave and 5th is a 4th

MULTIPLICATION of INTERVALS.

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BECAUSE it is the same Interval whether the greater or lesser Number be Antecedent of the Ratio, and in all Multiplication the Multiplier must be an absolute Number, therefore Multiplication of Intervals is an Application of Probl. 6. without any Variation or Limitation. I need therefore only make Examples, and refer to that Problem for the Rule.

by a whole Number. Example. To multiply a 5th 2:3 by 4. the Product is 16:81 the 4th Power of 2 and 3; and the Series of intermediate Terms being filled up is 16:24:36:54:81, expressing 4. Intervals in the continued Ratio of 2:3.

CASE II. To multiply an Interval by a Fraction. Example. Multiply the Interval 8: 27 by $\frac{2}{3}$, the Product, i. e. $\frac{2}{3}$ Parts of the given Interval is 4:9, for $\frac{4}{5}$ is the Square of the cube Root of $\frac{8}{27}$. See this Series, 8:12:18:27, in the continued Ratio of 2:3, where 8:18 (or 4:9) is plainly 2 Thirds of 8:27.

Note. If these Two Cases are joyned we can multiply any Interval by any mixt Number: Or we may turn the mixt Number to an improper Fraction, and apply the 2d Case.

COROLLARY. From the Nature of Multiplication it is plain, that we have in these Cases a Rule for finding an Interval, which shall be to any given one, as any given Number to any other; for 'tis plain it we take thefe given Numbers in form of a Fraction, and by that Fraction multiply the given Interval, we shall have the Interval fought, which is to that given as the Numerator to the Denominator; so in the preceeding Example, the Interval 4:9 is to 8: 27 as 2 to 3. But observe, if the Root to be extracted cannot be found, then the Problem, frictly speaking, is impossible, and we can express the Interval fought only by irrational Numbers. Example. To multiply a 4th 3: 4 by ; ie. to take ? Parts of it, it can only be expressed by the Ratio of the Cube Root of 9 to the Cube Root of 16, or the Square of the Cube Root of 3, to the Square of the Cube Root of 4. And the best we can do with such Cases, if they are to be reduced to Practice, is to bring the Extraction of the Root as near the Truth as may ferve our Purpose without a very groß Error.

But if 'tis proposed to find Two Intervals that are as Two given Numbers, this can eafily be done by multiplying any Interval, taken at Pleasure, by the Two given Numbers severally; tis plain the Products are in the Ratio of these

make the least of the given Numbers the N merator card the other, and Denominatoriol

Numbers.

DIVISION of INTERVALS.

HERE also there is nothing but the Application of Probl. 7. to which I refer for the

Rules, and only make Examples.

PROBLEM XII. Case 1. To divide an Interval by a whole Number, i. e. to find such an aliquot Part of that Interval as the give n Number denominates.

Example. Divide the Interval 4: 9 by 2, that is, find the Half of it; the Answer is a 5th 2:5, for Two 5hts make 4:9, as in this

Series, 4:6:9.

CASE II. To divide an Interval by a Fraction, that is, to find an Interval that shall be to the given one, as the Denominator of the Fraction to the Numerator.

Example. Divide the Interval 1: 4 by 3, the Quote is 1: 8, which is to 1: 4, as 3 to 2.

See this Series, 1, 2, 4, 8.

NOTE. To divide by a mixt Number, we can turn it to an improper Fraction, and do as in Cale 3.

OBSERVE. As Multiplication and Division are directly opposite, so we have by Division as well as by Multiplication, a Rule to find an Interval, which shall be to a given one, as any given Number to another: Thus, if the Interval sought must be greater than the given one, make the least of the given Numbers the Numerator, and the other the Denominator of a Fraction, by which divide the given Interval;

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but if the fought Interval must be lesser than the given, make the greater Number the Numerator; which is all directly opposite to the Rule of Multiplication: And, as I have already observed in Multiplication, if the Roots to be extracted by the Rule cannot be found, then there is no Interval that is accurately to the gi-

ven one as the Two given Numbers.

CASE III. To divide one Interval by another; that is, to find how oft the lesser is contain'd in the greater. Rule. Substract (by Probl. 10.) the leffer from the greater, and the same Divisor from the last Remainder continually till the Remainder be a Ratio of Equality, or change the Species; the Number of Substractions, if you come to a Ratio of Equality, is the Number of Times the whole Divisor is to be found in the Dividend: But if the Species change, the Number of Substractions preceeding that in which the Remainder changed, is the Number fought: But then, there is a Remainder which belongs also to the Quote, and it is the Remainder of the Operation preceeding that which changed; fo that the Dividend contains the Divisor so oft as that Number of Substractions denotes and contains that Remainder over, which is properly the Remainder of the Division.

EXAMPLE I. To find how oft the Interval 64: 125 contains 4:5. By the Rule I find

Three Times.

EXAMPLE II. To find how oft an 80e 1 : 2 contains a 3d g. 4: 5. you'll find Three Times, K 2

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and this Interval over, viz.125: 128. For, First, I substract 4:5 from 1:2, the first Remainder is 5:8; from this I substract 4:5, the 2d Remainder is 25:32; from this I substract 4:5, the 3d Remainder is 125:128; from this I substract 4:5, the 4th Remainder is 625:512, which is of a different Species, the Antecedent being here greatest, which in the other Ratio is least; therefore the Quote is 3, and the Ratio or Interval 125:128 over. See the Proof in this Series, 64:80:100:125:128. which is in the continued Ratio of 4:5. 64:125 is equal to Three times 4:5, and 64:128 is

equal to 1:2. THUS far only I proceeded with the Answer in Case 3. of Probl. 7. for dividing of one Ratio by another. Now I add, that if we would make the Quote complete and perfect, fo that it may accurately shew how many Times and Parts of a Time the Dividend contains the Divisor, (if 'tis possible) then proceed thus, viz. Take the Remainder preceeding that which changed, by it divide the given Divifor, until you come to a Ratio of Equality, or till the Species change, and then take the Remainder (preceeding that which changed of this Division) and by it divide the last Divifor; and fo on continually till you find a Division that ends in a Ratio of Equality; then take the given Dividend and Divisor, and the Remainders of each Division, and place them all in order from Left to Right, as in the following Example. Now, each of these Ratios having been divided by the next rst,

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next towards the right Hand, they have all been Dividends except the least (or that next the right) therefore over each I write the Quote or whole Number of Times the next leffer was found in it; then numbring these Dividends and Quotes from the Right, I fet the first Quote under the first Dividend, and multiplying the first Quote by the second, and to that Product adding 1, I fet the Sum under the 2d Dividend: Again, I multiply that last Sum by the 3d Quote, and to the Product add the Quote fet under the first Dividend; and this Sum I fet under the 3d Dividend; again, I multiply the last Sum by the 4th Quote, and to the Product add the Number set under the 2d Dividend, and I set this Sum under the 4th Dividend; and fo on continually, multiplying the Number fet under every Dividend by the Quote fet over the next Dividend (on the Left), to the Product I add the Number set under the last Dividend (on the Right): When all this is done, the Numbers that stand under each Dividend, express how oft the last Divisor (which is the first Number on the Right of the Series of Dividends) is contained in each of these Dividends; and consequently these Dividends are to one another as the Number set under them: Therefore, in the last Place, if the Numbers under the given Dividend and Divisor are divided, the greater of them by the leffer, the Quote fignifies how oft the Interval given to be divided contains the other given one.

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EXAMPLE.

EXAMPLE. Divide the Interval 1: 2048 by 1: 16. According to the Rule I substract 1: 16 from 1: 2048, and have two Substractions, with a Remainder 1:8 (for the 4th Substraction changes the Species) then I substract 1:8 from 1: 16, and after one Substraction there remains 1: 2 (the 2d Substraction changing.) Again I substract 1: 2 from 1: 8, and after Three Substractions there remains a Ratio of Equality. Now place these according to the Rule, as in the following Scheme, and divide 11 by 4, the Quote

shews, that the 2 1 3 given Dividend 1: 2048, 1: 16, 1: 8, 1: 2 1:2048, contains 11 4 3 the Divifor 1: 16, 2 and 3

Parts of a Time, i. e. that it contains 1: 16 twice; and moreover. 3 4th Parts of 1: 16, which you may view all in this Series 1: 2:4: 8: 16: 32: 64: 128: 256: 512: 1024: 2048; in the continual Ratio of 1: 2; in which we fee 1: 16 contained two Times, as in these three Terms 1:16: 256, then remains 256: 2048, equal to 1:8. which you fee is equal to 3 4th Parts of 1: 16, viz. three Times 1: 2, which is a 4th of 1: 16, as you fee in the Series.

For a more general Demonstration, suppose any Quantity, Number or Interval, reprefented by a and a leffer by b; let a contain b Two Times (which Two is fet over a) and c the Remainder. Again let b contain c Three times (which Three is fet over b) and d the

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the ReRemainder. Then let c contain d Five times (which Five is fet over c) and e the Remainder. Lastly, Let d contain e Four times (set over d) and no Remainder (i. e. a Ratio of Equality.) Now because d contains e Four times, I set 4 under d,

then c containing d Five times, and d containing e Four times, therefore c must contain e as many

times as the Product of Five into Four, viz. Twenty times; but because c is equal to Five times d and to e over, and e is contained in the Remainder, viz. it felf once, therefore e is contained in c Twenty one times. Again b contains c Three times and d over, and c contains e Twenty one times precifely, therefore b must contain e as oft as the Sum of Three times 21, viz. 63 and 4 which is 67; then a contains b Two times and c over, also b contains e Sixty feven times, therefore a contains e as oft as the Sum of Two times Sixty feven, viz. 134 and 21, which is 155. The other Inferences are plain, viz. 1mo. That each of those Intervals a: b: c, &c. are to one another, as the Numbers fet under them; for these are the Numbers of Times they contain a common Measure e, And confequently, 2do. If any of these Numbers be divided by another, the Quote will shew how oft the Interval under which the Dividend stands, contains the other.

COROLLARY. Thus we have found a Way to discover the Ratio betwixt any Two Inter-

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vals, if they are commensurable; so in the preceeding Example, the Interval 1:2048 is to 1:16, as the Number 11 to 4. But observe, if the Divisions never came to a Ratio of Equality, the given Intervals are not commensurable, or as Number to Number; yet we may come near the Truth in Numbers, by carrying on the Division a considerable Length.



CHAP. V.

Containing a more particular Confideration of the Nature, Variety and Composition of Concords, in Application of the preceeding Theory.

E have already distinguished and defined simple and compound Intervals, which we shall now particularly apply to that Species of Intervals which is called CONCORD.

DEFINITION. A fimple CONCORD is such, whose Extremes are at a Distance less than the Sum of any Two other Concords. A compound CONCORD is equal to Two or more Concords. This in general is agreeable to the common Notion of simple and compound; but the Definition is also taken another Way among the Writers on Musick; thus an Ostave

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1: 2, and all the lesser Concords (which have been already mentioned) are called simple and original Concords; and all greater than an Octave are called compound Concords because all Concords above an Octave are composed of, or equal to the Sum of one or more Octaves, and some single Concord less than an Octave; and are ordinarily in Practice called by the Name of that simple Concord; of which afterwards.

§ 1. Of the original Concorps, their Rise and Dependence on each other, &c.

See these original Concords again in the sollowing Table, where I have placed them in Order, according to their Quantity.

Table of simple CONCORDS.

5: 6 a 3d l.

LET us now first examine
4: 5 a 3d g. the Composition and Relations
3: 4 a 4th. of these original Concords a2: 3 a 5th. mong themselves.

1: 2 a 8ve. If we apply the preceeding Rules of the Addition and Subfiraction of Intervals to these

divided into simple and compound, according to

the first and more general Notion, in the Manner expressed in the following Table.

| Simple. | I Con | P | Proof in Numb. | | | | | |
|----------------|----------|---------|----------------|----|----|----|--|--|
| 5 : 6. a 3d 7. | ith. | 3d g. & | 3d 1. 4. | 5. | 6. | | | |
| 4:5,23dg. | oth g. D | 4th, | 3d g. 3. | 4. | 5. | 0 | | |
| | ofe | fith, | 4th. or | 3. | 4. | | | |
| 33 4. 24 4411. | ave. | Soth 1. | 3d g. or 4. | 2. | 8. | | | |
| Activities who | | 13d g. | 3d 1.4th 4. | 5. | 6. | 8. | | |

The 3d l. 3d g. and 4th, are equal to the Sum of no other Concords; for the 3d l. is it felf the least Interval of all Concords. The 3d g. is the next, which is equal to the 3d l. and a Remainder which is Discord. The 4th is equal to either of the 3ds and a Discord Remainder; and these Three are therefore the least Principles of Concord, into which all other Intervals are divisible: For the Composition of the 5th, 6th and 8ve, you see it proven in the Numbers annexed; and that they can be compounded of no other Concords, you'll prove by applying the Rules of Addition and Substraction.

As to the Proofs in Numbers which are annex'd, they demonstrate the Thing, taking the component Parts in one particular Order; but it is also true in whatever Order they are taken, as is proven in *Probl.* 2. Chap. 4. Or see all the Variety in this Table; in the last Column of which you see the Names of all the component Parts set down in the several Orders of which

which they are capable, either from the acuteft Term or the gravest.

TABLE of the various Orders of the harmonical Parts of the greater Concords.

$$5th, 2:3 \begin{cases} 4 \cdot 5 \cdot 6 & 3d g \cdot 3d l \cdot \\ 10 \cdot 12 \cdot 15 & 3d l \cdot 3d g \cdot \end{cases}$$

$$6th, l.5:8 \begin{cases} 5 \cdot 6 \cdot 8 & 3d l \cdot 4th \cdot \\ 15 \cdot 20 \cdot 24 & 4th \cdot 3d l \cdot \end{cases}$$

$$6th, g.3:5 \begin{cases} 3 \cdot 4 \cdot 5 & 4th \cdot 3d g \cdot \\ 12 \cdot 15 \cdot 20 & 3d g \cdot 4th \cdot \end{cases}$$

$$\begin{cases} 2:3:4 & 5th \cdot 4th \cdot \\ 3 \cdot 4 \cdot 6 & 4th \cdot 5th \cdot \end{cases}$$

$$\begin{cases} 3 \cdot 5 \cdot 6 & 6th g \cdot 3d l \cdot \\ 5 \cdot 6 \cdot 10 & 3d l \cdot 6th g \cdot \end{cases}$$

$$\begin{cases} 4 \cdot 5 \cdot 8 & 3d g \cdot 6th l \cdot \\ 5 \cdot 8 \cdot 10 & 6th l \cdot 3d g \cdot \end{cases}$$

$$\begin{cases} 3 \cdot 4 \cdot 5 \cdot 6 & 4th \cdot 3d g \cdot 3d l \cdot \\ 4 \cdot 5 \cdot 6 \cdot 8 \cdot 10 & 3d l \cdot 4th \cdot 3d g \cdot \end{cases}$$

$$\begin{cases} 3 \cdot 4 \cdot 5 \cdot 6 \cdot 8 \cdot 10 & 3d l \cdot 4th \cdot 3d g \cdot \\ 4 \cdot 5 \cdot 6 \cdot 8 \cdot 10 & 3d l \cdot 4th \cdot 3d g \cdot \end{cases}$$

$$\begin{cases} 10 \cdot 12 \cdot 15 \cdot 20 \cdot 24 \cdot 3d g \cdot 4th \cdot 3d l \cdot \end{cases}$$

Here you may observe, that the Varieties of the Composition of Octave by Three Parts, vize 3d g. 3d l. 4th, include the other Three Ways by Two Parts; and also all the Varieties of the Composition of the 5th and 6th.

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4th, 3d l. 3d g.

We have already, by Addition of the various Concords within an Octave, found and proven that the 5th, 6ths and 8ve, are equal to the Sum of lesser Concords, as in the preceeding Table: Now we shall consider, by what Laws of Proportion these Intervals are resolvable back into their component Parts; or, how to put such middle Numbers betwixt the Extremes of these Intervals, that the intermediate Ratios shall make harmonical Intervals; by which we shall have a nearer View of the Dependence of these original Concords upon one another.

Or the Seven original Concords we examine their Composition among themselves, i. e. what lesser ones the greater are equal to; therefore the Octave being the greatest, its Resolutions must include the Resolutions of all the rest.

PROPOSITION I. If betwixt the Extremes of an Octave we place au arithmetical Mean (by Corol. to Theor. 2. Chap. 4.) it shall resolve it into Two Ratios, which are the Concords of 5th and 4th; and the 5th shall be next the lesser Extreme: So betwixt 1 and 2 an arithmetical Mean is 1,; or because 1 and 2 can have no middle Term in whole Numbers; therefore if we multiply them by 2, the Products 2 and 4 being in the same Ratio, can receive one arithmetical Mean (by Theor. 8th) which Mean is 3, and the Series 2:3:4, viz. a 5th and a 4th.

of an Ostave we take an harmonical Mean, by Theor. 14th, the intermediate Ratios shall be

a 4th and a 5th, and the 4th next the leffer Extreme : so betwixt 1 : 2 an harmonical Mean is 1; or multiplying all by 3, to bring them to whole Numbers, the Series is 3, 4, 6, which is harmonical.

COROLLARY. 'Tis plain, that if betwixt the Extremes of the Octave we put Two Means, one arithmetical and one harmonical, the Four Numbers shall be in geometrical Proportion, as here, 6, 8, 9, 12. The Reason is, that the 4th and 5th are the Complements of each other to an Octave; and therefore a 4th to the lower Extreme leaves a 5th to the upper, and contrarily: And in this Division of the Octave, we have the Three Kinds of Proportion, ARITH-METICAL, HARMONICAE and GEOME-TRICAL, mixt, for 6:9:12. 712. the 5th, 4th, and 8ve, are arithmetical; 6:8:12, the 4th, 5th, and 8ve, are harmonical; and 6:8:9: 12, geometrical.

OBSERVE. The 5th and 4th are the Refult of the immediate and most simple Division of the Octave into Two Parts: The 4th is not resolu vable into other Concords, fince the only leffer Concords are the 3dg. and 3dl. and either of these taken from a 4th, leaves a Difcord; and therefore tis in vain to feek any mean Terms, that will resolve it into Concords. 'Tis natural therefore next to enquire into the Refolutions of the 5th, which by a remarkable Uniformity, we find reducible into its constituent lesser Concords

by the same Laws of Proportion.

put betwixt the Extremes of a 5th, resolves it it into a 3d g. and a 3d l. with the 3d g. next the lesser Extreme, as here, 2:2:3:3. which multiplied by 3 are reduced to these whole Numbers 4:5:6.

PROPOSITION IV. An harmonical Mean put betwixt the Extremes of a 5th, resolves it into a 3d g. and 3d l. with the 3d l. next the lesser Extreme; as 2:2; :3, which multiplied by 5

are reduced to thefe, 10:12:15.

here as from the two first Propositions, viz. That taking both an arithmetical and harmonical Mean betwixt the Extremes of a 5th, the Four Numbers are in geometrical Proportion, as in these, 20, 24, 25, 30.

Now out of the various Mixtures of these simple Divisions of the 8ve and 5th, we can bring not only all the Resolutions of the 6th, and the other Resolutions of the 8ve, but all the Varieties with respect to the Order in which the Parts can be taken, as follows, viz.

the Octave, we mix the arithmetical Division of the Octave, we mix the arithmetical Division of the 5th, i. e. if we put an arithmetical Mean betwixt the Extremes of the Octave, and then another arithmetical Mean betwixt the lesser Extreme and the last mean Term found, and reduce all the 4 to whole Numbers, then we have this Series 4, 5, 6, 8, in which we have the Octave resolved into its three consituent Concords, 3d greater, 3d lesser, and 4th; and within

within that Series the 5th resolved into its two constituent Concords, 3d greater, and 3d leffer: And if we consider the Extremes of the Octave with the least of the two middle Terms 5, then these 4, 5, 8 shew us the Octave refolved into a 3d g. and a 6th l. Lastly. It shews us the 6th 1. resolved into a 3d 1. and

a 4th, viz. 5, 6, 8.

2do. I F we mix the harmonical Division of Octave, with the arithmetical Division of the 5th, i. e. if we put an harmonical Mean betwixt the Extremes of Octave, and then an arithmetical Mean betwixt the greatest Extreme and middle Term last found, as in this Series, 3, 4, 5, 6, then we have the Refolution of the Octave into a 6th g. and 3d l. as in these 3, 5, 6; also the 6th g. resolved into a 4th and 3d g. in these, 3, 4, 5; and taking the whole Series, we have a 2d Order of the Three Parts of the Octave.

WE have feen all the harmonical Parts of . the Octave and 5th, and both the 6ths; and as to the Variety of Order in which these may be placed betwixt the Extremes, it may all be found by other Mixtures of the Parts of the Octave, and 5th or 6th; as you'll easily find by comparing the 6 Orders of the Composition of Octave by 3 Concords, in the preceeding Table.

O R, you may find them all in one Series, if you'll divide the Octave thus, viz. Put both an arithmetical and harmonical Mean betwixt its Extremes, and you'll have a 4th and 5th to each of the Extremes; both of which 5ths divide

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arithmetically and also barmonically, and at every Division reduce all to a Series of whole Numbers; and 'tis plain you'll have a Series of 8 Terms, among which you'll have Examples of the 7 original Concords with their Compofitions, and all the different Orders in which their Parts can be taken. Or, you may make the Series by taking the 7 Concords, and redueing them to a common Fundamental, by Problem 3. the Series is 360: 300: 288: 270: 240: 225: 216: 180. See Plate 1. Fig. 4. wherein I have connected the Numbers fo as all the Composition may be easily traced.

THERE is this remarkable in that Series, that you have all the Concords in a Series, both ascending toward Acuteness from a common Fundamental, or greatest Number 360, and descending towards Gravity, from a common acute Term 180. and for that Reason the Series has this Property, that taking the Two Extremes, and any other Two at equal Distance, these 4 are in geometrical Propor-

tion.

Nota. I F betwixt the Extremes of any Inrerval you take Two middle Terms, which shall be to the Extremes in the Ratios of any Two component Parts of that Interval, i. e. if the two middle Terms divide the Interval into the Same Parts only in a different Order, the Four Numbers are always geometrical.

Now, from the Things last explained, we shall make some more particular Observations concerning

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concerning the Dependence of the original Con-

cords one upon another.

THE Octave is not only the greatest Interval of the Seven original Concords, but the first in Degree of Perfection; the Agreement of whose Extremes is greatest, and in that respect most like to Unisons: As it is the greatest Interval, fo all the leffer are contained in it; but the Thing most remarkable is, the Manner how these lesser Concords are found in the Octave, which shews their mutual Dependences; by taking both an harmonical and arithmetical Mean betwixt the Extremes of the Octave, and then both an arithmetical and harmonical Mean betwixt each Extreme, and the most distant of the Two Means last found, viz. betwixt the lesser Extreme, and the first arithmetical Mean, also betwixt the greater Extreme and the first harmonical Mean we have all the leffer Concords: Thus if betwixt 360 and 180 the Extremes of Octave, we take an arithmetical Mean, it is 270, and an harmonical Mean is 240; then betwixt 360, the greatest Extreme, and 240, the harmonical Mean, take an arithmetical Mean, it is 300, and an harmonical Mean is 288; again, betwixt 188 the lesser Extreme of the Octave, and 270 the first arithmetical Mean, take an arithmetical Mean, it is 225, and an harmonical it is 216, and the whole Numbers make this Series, 360:300 i 288: 270: 240: 216: 180.

OBSERVE. The immediate Division of the Ottave resolves it into a 4th and 5th; the a-

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rithmetical Division puts the 5th next the leffer Extreme, as here 2, 3, 4, and the har-monical puts it next the greater Extreme, as here 3:4:6; and you may fee both in thefe four Numbers 6, 8, 9, 12. Again the immediate Division of the 5th produces the Two ads; the arithmetical Division puts the lesser 3d, and the harmonical the greater 3d next the lesser Extreme; as in these 4, 5, 6, and 10, 12, 15; or fee both in one Series, 20, 24, 25, 30. The two 6ths are therefore found by Divifion of the Octave, tho' not by any immediate Division. The same is true also of the two 3ds; so that all the other simple Concords' are found by Division of the Octave. The 5th and 4th arife immediately and directly out of it, and the 3ds and 6ths proceed from an accidental Division of the Octave; for the 3ds arise immediately out of the 5th, which having one Extreme common with the Octave, the mean Term which divides it directly, divides the Octave in a Manner accidentally.

Now, if we consider how perfectly the Extremes of an Ostave agree, that when they are sounded together, it is impossible to perceive two different Sounds; so great is their Likeness, and the Mixture so evenly, that it is impossible to conceive a greater Agreement; we see plainly there is no Reason to expect that there should be any other Concord within the Order of Nature that comes nearer, or so near to the Perfection of Unilons: And if we consider again, how these Seven original Concords gradually decrease

decrease from the Octave to the lesser 6th. which has but a small Degree of Concord; and with that Consideration joyn this of the mutual Dependence of these Seven Concords upon one another, and especially how they all rise out of the Division of the Octave, according to a most simple Law, viz. The taking an arithmetical and harmonical Mean betwixt its Extremes which gives the Two Concords next in Perfection to the Octave, whereof the 5th is best; and the same Law being applied to this, discovers all the rest of the Concords; for out of the 5th arise immediately the two 3ds, whose Complements to Octave are the two 6ths; and for that Reason these 6ths and 3ds are said to rise accidentally out of the Octave; (and afterwards we shall fee how by the same Law, some other principal Intervals belonging to the System of Musick are found.) Upon all these Considerations we may be fatisfied, that we have discovered the true natural System of Concords within the Octave; and that we have no reasonable Ground to believe there are any more, nor even a Possibility of it, according to the present State and Order of Things.

Now as to the Order of their Perfection, we have already stated them according to the Ear hus, Octave, 5th, 4th, 6th gr. 3d gr. 3d less. 6th he best Concords are exprest by least Numbers. et, as I observed, this is not an universal Chaacter; and we are only certain of this from experience, that the frequent Coincidence of Vi-

brations,

brations, is a necessary Part of the Cause of Harmony; Sense and Observation must supply the rest, in determining the Preference of Concords; and fo we take thefe 7 original Concords in the Order mentioned; and upon what Confiderations they are otherways ranked by practical Musicians, shall be explain'd in its belimind

proper Place.

YET before I go further, let us notice this one Thing concerning the Difference of the arithmetical and barmonical Division. An arithmetical or harmonical Mean put betwixt the Extremes of any Interval, divides it into two unequal Parts; the arithmetical puts the greatest Interval next the lesser Extreme, the harmonical contrarily, as in these, 2:3:4, and 3:4:6, where the Octave is divided into its constituent 5th and 4th; or the Resolutions of the 5th, as here 4:5:6, and 10:12: 15. Now let us apply these Numbers either to the Lengths of Chords or their Vibrations, and we find this Difference, that applied to the Vibrations, the arithmetical Division puts the best Concord next the fundamental, or grave Extreme, and the harmonical puts it next the acute Extreme; but contrarily in both when applied to the Lengths of Chords. As these two Divisions resolve the Octave or 5th into the fame Parts, they are in that respect equal; but if we suppose the Extremes of the Octave or 5th, with their arithmetical or harmonical Means, to be founded all together, there will be a confiderable Difference; and that Division which

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which puts the best Concord lowest is best, which is the arithmetical if the Numbers are applied to the Vibrations, but the harmonical if applied to the Lengths of Chords. The obferving this shall be enough here; I shall more fully explain it when I treat of compound Sounds, under the Name of Harmony. This however we find true, That geometrical Proportion atfords no simple Concords (how it comes among the compound shall be seen presently) and it has no Place in the Relation and Dependence of the original Concords, but so far as a Mixture of the arithmetical and harmonical produces it, as in these, 6, 8, 9, 12. And here I shall observe, That the harmonical Proportion received that Denomination from its being found among the Numbers, applied to the Length of Chords, that express the chief Concords in Musick, viz. the Octave, 5th, and 4th, as here, 3, 4, 6. But this Proportion does not always constitute Concords, nor can possibly do because betwixt the Extremes of any Interval we can put an harmonical Mean, yet every Interval is not refolvable into Parts that are Concords; therefore this Definition has been rejected, particularly by Kepler; and for this he institutes another Definition of harmonical Proportion, viz. When betwixt the Extremes of any Ratio or Interval, one or more middle Terms are taken, which are all Concord among themselves, and each with the Extremes, then that is an harmonical Division of such an Interval; so that Octave, 6th and 5th are capable

of being barmonically divided in this Sense; all the Variety whereof you see in a Table at the Beginning of this Chapter: And these middle Terms will be in some Cases arithmetical Means, as 1:2:3; in some geometrical, as 1, 2, 4; in some harmonical (in the first Sense) as 3:4:6; and in others they will depend on no certain

Proportion, as 5, 6, 8.

HITHERTO we have considered the Refolution and Composition of Intervals, as they are exprest by Ratios of Numbers; but there are other Ways of deducing the Relation and Dependence of the Concords, not from the Division or Resolution of a Ratio, but the Division of a simple Number, or rather of a Line exprest by that Number, which may be call'd the geometrical Part of this Theory. But it will be better if I first consider and explain the remaining Concords belonging to the System of Musick, which are particularly called compound Concords.

§ 2. Of COMPOUND CONCORDS; and of the Harmonick Series; with several Observations relating to both simple and compound Concords.

TITHERTO we have taken it upon Ex-I perience, That there are no concording Intervals greater than Octave, but what are composed of the 7 original Concords within an Octave; the Reason of which is deduced from the Perfection of the Octave. We have feen already how all the other simple and original Concords are contained in, and depend upon the Offave, and derive their Sweetness from it, as they arise more or less directly out of it: We have observed, that it has in all Respects the greatest Perfection of any Interval, and comes nearest to Unisons; and tho' there seems to be fomething still wanting, to make a general Character, by which we may judge of the Approach of any Interval to the perfect Agreement of Unisons, yet 'tis plain the Octave 1:2 comes nearest to it; for 'tis contained not only in the least of all Numbers, but that Proportion is of the most perfect Kind, siz. Multiple; and of all fuch it is the most simple, which makes the greatest Degree of Commensurateness or Agreement in the Motions of the Air that produce these Sounds. Let me add this

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168 A TREATISE CHAP. V. other Remark, That if Wind-instruments are overblown, the Sound will rife first to an Octave, and to no other Concord; why it should not as well rife to a 4th, &c. is owing probably to the Perfection of Octave, and its being next to Unison. Again, take into the Consideration that surprising Phanomenon of Sound being raifed from a Body which is touched by nothing but the Air, moved by the fonorous Motion of another Body; particularly that if the Tune of the untouched Body be Octave above the given Sound, it will be most distinctly heard; and scarcely will any other but the Octave be heard.

FROM this simple and perfect Form of the Octave, arises this remarkable Property of it, that it may be doubled, tripled, oc. and still be Concord, i. e. the Sum of Two or more Octaves are Concord, tho' the more compound will be gradually less agreeable; but it is not so with any other Concord less than Octave, the Double, &c. of these being all Discords; and as continued geometrical Proportion constitutes a Series of equal Intervals, to we fee that fuch a Series has no Place in Mulick but among Octaves, the Continuation of other Concords producing Difcord. Thefe Things remarkably confirm to us the Perfection of the Octave: 'There is fuch a Likeness and Agreement betwixt its Extremes, that it feems to make a Demon-Aration a priori, that whatever Sound is Concord to one Extreme of the Octave, will be fo to the other also; and in Experience it is so. We

We have feen already, that whatever Sound betwixt the Extremes of an Offave, is Concord to the one, is in another Degree Concord to the other also; for we found that the Octave is resolvable into Concords. Again, if we add any other fimple Concord to an Octave, we find by Experience that it agrees to both its Extremes; to the nearest Extreme it is a simple Concord, and to the farthest it is a compound Concord: Now, take this for a Principle, That whatever agrees to one Extreme of Octave, agrees also to the other; and we easily conclude, That there cannot be any concording Interval greater than an Octave, but the Compounds of an Octave and some lesser Concord: For if we suppose the Extremes of any Interval greater than an Octave to be Concord, 'tis plain we can put in a middle Term, which shall be Octave to one Extreme of that Interval, consequently the other Extreme shall be also Concord with this middle Term, and be distant from it by an Interval less than an Octave; and therefore if we add a Discord to one Extreme of an Octave, it will be also Discord to the other; the same will apply also to the Compounds of Two or more Octaves; but the Agreement will still be less as the Composition is greater.

I cannot but mention here how D' Cartes concludes this Principle to be true; he observes, what I have done, That the Sound of a Whistle or Organ-pipe will rife to an Octave, if 'tis forcibly blown; which proceeds.

fays he, from this, That it differs least from Unison. Hence again, says he, I judge that no Sound is heard, but its acute Octave seems some way to eccho or resound in the Ear; for which Reason it is that with the grosser Chords (or those which give the graver Sound) of some ftringed Instruments (he mentions the Testudo) others are joyned an Octave acuter, which are always touched together, whereby the graver Sound is improven, so as to be more distinctly heard. From this he concludes it plain, That no Sound which is Concord to one Extreme of an Octave, can be Difcord to the other. From all this we fee how the Octave comprehends the whole System of Concords, (excepting the Uni-son) because they are all contained in it, or composed of it and these that are cotained in it.

The Author already mentioned of the E-lucidationes Physica upon D' Cartes's Compend of Musick, advances an Hypothesis to explain how this happens, which D' Cartes affirms, viz. That the Fundamental never sounds but the acute Octave seems to do so too. He supposes that the Air contains in it several Parts of different Constitution, capable, like different Chords, of different Measures of Vibrations, which may be the Reason, says he, that the human Voice or Instruments, and chiefly these of Metal never sound, but some other acuter

Sounds are heard to refound in the Air.

In the Beginning of this Chapter I observed two different Senses in which Concords were called fimple and compound: The Octave and all all within it are called fimple and original Concords; and all greater than an Octave, are compound, because all such are composed of an Octave, and some lesser Concord. Now, the 5th, 6ths and Octave are also composed of the 3ds and 4ths which are the most simple Concords; but then all the 7 Concords within an Octave have different Effects in Musick, whereas the compound Concords above an Offave have all in Practice the same Name and Effect with these simple ones, less than an Octave, of which with the Octave they are composed; so a 5th and an Octave added make, 1: 3, and is called a compound 5th. Now as there are 7 original Concords, fo these 7 added to Octave, make 7 compound Concords; and added to two Octaves, make other 7 more compound, and fo on. We have feen already, in Prob. 8. how to add Intervals, and according to that Rule I have made the following Table of Concords, which I place in Order, according to the Quantity of the Interval, beginning with the leaft. I fuppose I to be a common fundamental Chord, and express the acute Term of each Concord by that Fraction or Part of the Fundamental that makes fuch Concord with it, and have reduced each to its radical Form, i. e. to the lowest Number; fo an Octave and 5th added, is in the Ratio 2: 6, equal by Reduction to 1:3; and others.

Follows the general Table of CONCORDS,

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THESE Compounds are ordinarly called by the Name of the fimple Concord of which they are composed, tho they have also other Names, of

which in another Place.

le this Table were continued infinitely, 'tis plain we flould have all the possible harmonical Ratios, and in their radical Forms; 'tis also certain, that there should be no other Numbers found in it than these, 1, 3, 5, and their Multiples by 2, i.e. their Products by 2, which are 2, 6, 10, and the Products of these by 2, viz.

4,12,20, and so on in infinitum, multiplying the last Three Products by 2. The Reason of which is, that in this Series 1, 2, 2, 4, 5, 6, 8, we have no other Numbers but 1, 2, 3, and their Products by 2; and we have here also all the Numbers that belong to the simple original Concords; and if we consider how the Compounds are raised by adding an Octave continually, we see plainly that

no new Number can be produced, but the Product of these that belong to the simple Concords multiplied by 2 continually. All which Numbers make up this Series, vez. 1, 2, 3, 4, 5, 6, 8, 10, 12, 16, 20, 24, 32, 40, 48, 64, 80, Gc. which is continued after the Number 5, by multiplying the last Three by 2, and their * Products in infinitum by 2; whereby 'tis plain, we shall have all the Multiples of these original Numbers 1, 3, 5, arising from the continual Multiplication of them by 2. And this I call the HARMONICAL SERIES, because it contains all the possible Ratios that make Concord, either fimple or compound: And not only fo, but every Number of it is Concord with every other, which I shall easily prove: That it contains all possible Concords is plain from the Way of raising it, since it has no other Numbers than what belong to the preceeding general Table of Concords; and that every Number is Concord with every other is thus proven: After the Number 5 every Three Terms of the Series are the Doubles of the last Three; but the Numbers 1, 2, 3, 4, 5, are Concord each with another, and confequently each of these must be Concord with every other Number in the Series, fince all the rest are but Multiples of these; for whatever Concord any lesser Number of these 5 makes with another of them that is greater, it will with the Double of that greater make an Octave more, and with the Double of the last another Office more, and so on: Thus, 2 to 3, is a 5th, and 2 to 6 is a 5th and 80e; but, comparing any greater

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greater Number of these Five with a lesser, whatever Concord that is, it will with the Double of that lesser be an 8ve less, providing that Double be still less than the Number compared to it, (fo 5 to 2 is a 3d g. and 8ve, and 5 to 4 is only a ad g.) But it 'tis greater, then it will be the Complement of the first Concord to 8ve, i.e. the Difference of it and 8ve, (so 5 to 6 is a 3d l. the Complement of a 6th g. 5:3 to an 8ve) and taking another Double it will be an 8ve more than the last, and so on. Now the Thing being true of these Five Numbers compared together, and with all the other Numbers in the Series, it must hold true of all these others compared together, because they are only Multiples of the first. The Use of this barmonick Series you'll find in the next Chapter. I shall end this with fome further Observations relating to the harmonical Numbers, and the whole System of Concords both simple and compound.

In the preceeding Chapter I have endeavoured to discover some Character, in the Proportion of musical Intervals, whereby their various Persections may be stated, tho' not with all the Success to be wished; so that we are in a great Measure lest to Sense and Experience. We have seen that the principal and chief Concords, are contain'd within the first and least of the natural Series of Numbers; the Octave, 5th, 4th, and 3ds, in the natural Progression 1, 2, 3, 4, 5, 6; and the Two 6ths arise out of the Division of the Octave, and are contain'd in these Numbers 3, 5, 8. Considering what a necessary Condition

dition of Concord, frequent Union and Coincidence of Motion is, we have concluded, that the smaller Numbers any Proportion consists of, cateris paribus, the more perfect is the Interval expressed by such a Proportion of Numbers. But then I observed, that besides this Smalness of the Numbers on which the Coincidence depends, there is fomething still a Secret in the Proportion or Relation of the Numbers that represent the Extremes of an Interval, that we ought to know for making a general Character, whereby the Degrees of Concord may be determined; fo 4: 7 is Discord, and yet 5: 6 is Concord, and 5: 8. Now again we fee in this Table of Concords, that the Smalness of the Numbers does not absolutely determine the Preference, else 1: 3 an Octave and 5th, would be better than 1; 4 a double Octave, which it is not, and fo would all the other compound 5ths in infinitum. Again, the compound 3d 1:5 would be better than either the compound Octava 1: 8, or the compound 5th 1: 6, which is all contrary to Experience; and this demonstrates, that there must be fomething else in it than barely the Smalness of the Numbers. D' Cartes observes here, that the 3d 1:6, compos'd of Two Octaves, is better than either the simple 3d, 4:5, or the first Compound 2:5; and gives this Reason, viz. that 1:5 is a multiple Proportion, which the others are not; and o t of multiple Proportion, he fays, the best Concords proceed, because it is the most simple Form,

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the compound 5ths are better than the simple 5th; and D'Cartes himself makes the first compound 5th 1: 3 the most perfect, because it is Multiple, and in smaller Numbers than the simple 5th. But we insit observe, that every multiple Proportion will not constitute Concord, so 1: 9 is gross Discord, being equal to Three Octaves, and this Discord 8: 9. Now consider either the Numbers or their multiple Proportion, and this of 1: 9 should be better than 3: 8, or than 3: 16; yet it is otherwise, for these are compound 4ths, which are Concord; we must therefore refer this to some other thing, in the Relation of the Numbers, that we cannot express.

OBSERVE next how D' Cartes states these Concords; he puts them in this Order, Octave, 5th, 3d g. 4th, 6th g. 3d l. 6th l. and gives this Reason, viz. That the Perfection of any Concord is not to be taken from its simple Form only, but from a joynt Consideration of all its Compounds; because, says he, it can never be heard alone fo fimply, but there will be heard the Resonance of its Compound; as in the Uni-son, or a single given Sound, the Resonance of the acute Octave is contained; and therefore he places the d.d.g. before the 4th, because being contained in lesser Numbers, it is more perfect. But we must observe again, that as Concord does not depend altogether upon multiple Proportion, neither does it upon the Smalness of the Numbers; for then D' Cartes should have put the 5th before the Octaves, because all its

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Componuds are contained in leffer Numbers than the Octaves. We see then how difficult it is to deduce the Perfection of the Concords from the

Numbers that express them.

LET us consider this other Remark of D' Cartes, he observes that only the Numbers 2, 3, 5, are strictly mufical Numbers, all the other Numbers of the Table being only Compounds or Multiples of these Three, which belong in the first Place to the Octave, 5th, and 3d g. which he calls Concords properly, and per se, as he calls all others accidental, for Reasons I

shall show you immediately.

Now, tho' the compound 5ths are contain'd in lesser Numbers than the Octaves, perhaps the Preference of the Octaves is due to the radical Number 2, which belongs originally and in the first Place to that Concord; whereas the compound 5ths depend on the Number 3 which is more complex: But we shall leave this Way. of Reasoning as uncertain and chimerical; yet this we have very remarkable, that the first six of the natural Series of Numbers, viz. 1, 2, 3, 4, 5, 6, are Concords comparing every one with every other, which is true of no other Series of Numbers, except the Equimultiples of these 6, which, in respect of Concord, are the same with these. Again, if each of these Numbers be multiplied by it felf, and by each of the rest, and these Products be disposed in a Series, each Number of that Series with the next constitutes some Interval that belongs to the System of Musick, tho' they are not at all Concord, as Will will appear afterwards: That Series is 1. 2. 3. 4. 5. 6. 8. 9. 10. 12. 15. 16. 18. 20. 24. 25. 30. 36. It would be of no great Use to repete what wonderful Properties some Authors have found in the Number 6, particularly Kircher, who tells us, that it is the only Number that is absolutely harmonical, and clearly represents the divine Idea in the Creation, about which he imploys a great deal of Writing. But these are fine imaginary Discoveries, that I shall leave every one to satisfy himself about, by consulting their Authors or Propagators.

ANOTHER Thing remarkable in this System of Concords is, that the greatest Number of Vibrations of the Fundamental cannot be above 5, or, there is no Concord where the Fundamental makes more than 5 Vibrations to one Coincidence with the acute Term: For fince it is fo in the fimple Concords, it cannot be otherwife in the Compounds, the Octave being !, which by the Rule of Addition can never alter the lesser Number of any simple Concord to which it is added. It is again to be remarked, that this Progress of the Concords may be carried on to greater Degrees of Composition in infinitum; but the more compound still the less agreeable, if you'll except the Two Cases abovementioned of the 5th r: 3, and 3d 1:5; fo a single 0-Stave is better than a double Cstave, and this better than the Sum of 3 Octaves, &c. and foof 5ths and other Concords. And mind, tho' a compound Octave is the Sum of 2 or more Ostaves, yet by a compound 5th or other Concord,

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cord, is not meant the Sum of Two or more 5ths, but the Sum of an Octave and 5th, or of Two Octaves and a 5th, &c. Now, tho' this Composition of Concords may be carried on infinitely, yet 3 or 4 Octaves is the greatest Length we go in ordinary Practice; the old Scales of Musick were carried no further than 2, or at most 3 Octaves, which is fully the Compass of any ordinary Voice: And tho' the Octave is the most perfect Concord, yet after the Third O-Etave the Agreement diminishes very fast; nor do we go even so far at one Movement, as from the one Extreme to the other of a triple or double Octave, and feldom beyond a fingle Octave; yet a Piece of Musick may be carried agreeably thro' all the intermediate Sounds, within the Extremes of 3 or 4 Octaves; which will afford all the Variety of Pleasure the Harmony of Sounds is capable to afford, or at least we to receive: For we can hardly raife Sounds beyond that Compass, either by Voice or Instruments, that shall not offend the Ear. Chords are fittest for raising a great Variety of Degrees of Sound; and if we suppose any Chord; Foot long, which is but a finall Length to give a good Sound, the Fourth Octave below must be Eight Foot, which is fo long, that to give a clear Sound, it must have a good Degree of Tension; and this will require a very great Tension in the Foot Chord: Now if we go beyond the Fourth Octave, either the acute Term will be too fort, or the grave Term too long; and if in this the Length be supplied by the Grossness M 2

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ness of the *Chord*, or in the other the Shortness be exchanged with the Smalness, yet the Sound will by that means become so blunt in the one, or so slender in the other, as to be useless.

D' Cartes supposes we can go no further than Three Octaves, but he must mean only, that the Extremes of any greater Interval heard without any of the intermediate Terms, have little Concord to our Ears; but it will not follow, that a Piece of Musick may not go thro' a greater Compass, especially with many Parts.



CHAP. VI.

Of the Geometrical Part of Musick; or, how to divide right Lines, so as their Sections or Parts one with another, or with the Whole, shall contain any given Interval of Sound.

Tune, are justly express by the Lengths of Chords or right Lines; and the Proportions which we have hitherto explained being found, first by Experiments upon Chords, and

and again confirmed by Reasoning; the Division of a right Line into such Parts as shall constitute one with another, or with the Whole, any Interval of Sound is a very easy Matter: For in the preceding Parts we have all along supposed the Numbers to represent the Lengths of Chords; and therefore they may again be easily applied to them, which I shall explain in a few Problems.

§ 1. Of the more general Division of Chords.

PROBLEM TO assign such a Part of any right Line, as shall constitute any Concord (or other Interval) with the Whole.

Rule. Divide the given Line into as many Parts, as the greatest Number of the Interval has Units; and of these take as many as the lesser Number; this with the Whole contains the Interval sought. Example. To find such a Part of the Line A B, as shall be a 5th to the Whole. The 5th is 2:3, therefore I divide the Line into Three Parts, whereof 2, viz. A C, is the Part sought; that is, Two Lines, whose Lengths are as A B to A C, cateris paribus, make a 5th.

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Two or more different Sections of the Line A. B. that shall be to the Whole in any given Proportion. Tis plain, we must take the given Ratios, and reduce them to one Fundamental (if they are not so) by Probl. 3. Chap. 4. and then divide the Line into as may Parts as that Fundamental has Units; so, to find the Sections of the Line A. B. that shall be Octave, 5th and 3dg. I take the Ratios 1:2, 2:3, and 4:5, and reduce them to One Fundamental, the Series is 30:24, 20:15. the Fundamental, the Series is 30:24, 20:15. the Fundamental is 30, and the Sections sought are 24 the 3dg. 20 the 5th, and 15 the Octave.

PROBLEM II. To find feveral Sections of a Line, that from the least gradually to the Whole, shall contain a given Series of Intervals, in a given Order, i. e. fo as the least Section to the next greater shall contain a certain Interval, from that to the next shall be another; and so on. Rule. Reduce all the Ratios to a continued Series, by Probl. 2. Chap. 4. Then divide the Line into as many Parts as the greatest Extreme of that Series; and number the Parts from the one End to the other, and you have the Sections fought, at the Points of Division answering the several Numbers of the Series. Example. To find feveral Sections of the 'Line A B, fo that the least to the next greater shall contain a 3d g. that to the next greater a 5th, and that to the Whole an Octave. The Three Ratios 4:5, 2:3, 1:2, reduced to One Series, make 8: 10:15:30. So the Line

A B being divided into Thirty equal Parts, we have the Sections fought at the Points C D and E, fo as AC to AD is a 3d g. AD to AE a 5th, and AE to AB Octave.

NOTA. The Difference of this and the last Problem is, that there we found several Sections of the Line which were not considered as altogether precisely equal to the Whole; but here the Point sought must be such as their Sum shall

be exactly equal to the Whole.

COROLLARY. If it is proposed to divide a Line into more than Two Parts, which shall be to one another as any given Intervals from the least to the greatest; we must take the given Ratios, and reduce them to one continued Series, as in the last Probl. and add them all together; then divide the Line into as many Parts as that Sum.

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Example. To divide the Line AB into 4 Parts, which shall contain among them, from the least to the greatest, a 3d g. 4th and 5th, I take the Ratios 4:5, 3:4 and 2:3, which reduced to one Series, it is 12:15:20:30, whose Sum is 77; let the Line be divided into 77 Parts; and if you first take off 12, then 15, then 20, and lastly 30 Parts, you have the Parts sought equal to the Whole.

THE preceeding Problems are of a more general Nature, I shall now particularly treat of the

harmonical Division of Chords.

§ 2. Of the harmonical Division of Chords.

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Explained already Two different Senses in which any Interval is faid to be harmonically divided; the First, When the Two Extremes with their Differences from the middle Term are in geometrical Proportion; the 2d, when an Interval is so divided, as the Extremes and all the middle Terms are Concord each with another. Now, we are to consider, not the harmonical Division of an Interval or Ratio, but the Division of a fingle Number or Line, into fuch Sections or Parts as, compared together and with the Whole, shall be harmonical in either of the Two Senses mentioned, i.e. either with respect to the Proportion of their Quantity, which is the first Sense, or of their QuaQuality or Tune, which is the fecond Sense of harmonical Division.

PROBLEM IV. To find Two Sections of a Line which with the whole shall be in harmonical Proportion of their Quantity. To answer this Demand, we may take any Three Numbers in harmonical Proportion, as 3,4,6, and divide the whole Line into as many Parts as the greatest of these Three Numbers (as here into 6), and at the Points of Division answering the other two Numbers (as at 3 and 4) you have the Sections sought. And an infinite Number of Examples of this Kind may be found, because betwixt any Two Numbers given, we can put an harmonical Mean, by Theor. 11. Chap. 4.

Note. The harmonical Sections of this Pro-

Note. The harmonical Sections of this Problem added together, will ever be greater than the Whole, as is plain from the Nature of that Kind; and this is therefore not fo properly a Division of the Line as finding several Sections, or the Quotes of several distinct Divisions.

These Sections with the Whole, will also conflitute an harmonical Series of the 2d Kind, but not in every Case; for Example, 2, 4, 6, is harmonical in both Senses; also 2:3:6; but 21, 24, 28 is harmonical only in the First Sense because there is no Concord amongst them but betwixt 21, 28, (equal to 3:4.)

To know how many Ways a Line may be divided harmonically in both Senses, shall be pre-

fently explained.

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PROBLEM V. To find Two Sections of a Line, that together and with the Whole shall be har-

harmonical in the Second Sense; that is, in respect of Quality or Tune. Rule. Take any Three Numbers that are Concord each with another, and divide the Line by the greatest, the Points of Division answering the other Two give the Sections sought: Take, for Example, the Numbers 2, 3, 8, or 2, 5, 8, and apply them

according to the Rule.

I observed in the former *Problem*, That the Two Sections together are always greater than the whole Line; but here they may be either greater, as in this *Example*, 2, 3, 4, or less, as in this *Example*, 1, 2, 5, or equal, as here, 2, 3, 5, which last is most properly Division of the Line, for here we find the true constituent Parts of the Line: They may also be *harmonical* in the first Sense, as 2:3:6, or otherwise as

2:3:4.

Now, to know all the Variety of Combinations of Three Numbers that will folve this Problem, we must consider the preceding general Table of Concords, Pag. 172. and the harmanical Series made out of it, which contains the Numbers of the Table and no other. I have shewn that all the Numbers of the Table of Concords, are Concords one with another, as well as these that are particularly connected: We have also seen that, tho' the Table were carried on in infinitum, the lesser Number of every Ratio is one of these, 1. 2. 3. 4. 5; and the greater Number of each Ratio one of these, 2. 3. 5. or their Products by 2. in infinitum. Tis plain therefore, that if we suppose this Table of Concords

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cords carried on in infinitum, we can find in it infinite Combinations of Three Numbers that shall be all Concord. For Example, Take any Two that have no common Divisor, as 2:3, you'll find an Infinity of other Numbers greater to joyn with these; for we may take any of the Multiples in infinitum of either of these Two Numbers themselves, or the Number 5, or its Multiples: But if we suppose the Table of Concords limited(as with respect to Practice it is) fo will the Variety of Numbers fought be: Suppose it limited to Three Octaves, then the harmonical Series goes no farther than the Number 64, as here, 1. 2. 3. 4. 5. 6. 8. 10. 12. 16. 20. 24. 32. 40. 48. 64, &c. and as many Combinations of Three Numbers as we can find in that Series, which have not a common Divisor, so many Ways may the Problem be folved. But besides these we must consider again, that as many of the preceeding Combinations as are arithmetically proportional (fuch as 2. 3. 4, and 2. 5. 8) there are fo many Combinations of correspondent Harmonicals (in the first Sense) which will folve this Problem. These joyned to the preceeding, will exhauft all the Variety with which this Problem can be folved, supposing 3 Octaves to be the greatest Concord. Again, we are to take Notice, that of that Variety there are fome, of which the Two lesser Numbers will be exactly equal to the greatest, as 1. 2. 3. tho' the greater Numbers are otherwife.

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I shall now in Two distinct Problems show you, First, The Variety of Ways that a Line may be cut, so as the Sections compared together and with the Whole shall be harmonical in both the Senses explained; and 2do. How many Ways it may be divided into Two Parts equal to the Whole, and be harmonical in the Second Sense; for these can never be harmonical in the First Sense, as shall be also shewn.

PROBLEM VI. To find how many Ways 'tis possible to take Two Sections of a Line, that with the Whole shall constitute Three Terms harmonical both in Quantity and Quality.

FROM the harmonical Series we can easily find an Answer to this Demand: In order to which consider, First, That every Three Numbers in harmonical Proportion (of Quantity) have other Three in arithmetical Proportion corresponding to them, which contain the same Intervals or geometrical Ratios, tho' in a different Order; and reciprocally every arithmetical Series has a correspondent Harmonical, as has been explained in Theor. 14. Chap. 4. Let us next consider, That there can no Three Numbers in arithmetical Proportion be taken, which shall be all Concord one with another, unless they be found in the harmonical Series: Therefore it is impossible that any Three Numbers which are in harmonical Proportion (of Quantity) can be all Concord unless their correspondent Arithmeticals be contain'd in the harmonical Series. Hence 'tis plain, that as many Combinations of Three Numbers in arithmetical Proportion as can

can be found in that Series, fo many Combinations of Three Numbers in harmonical Proportion are to be found, which shall be Concord each with another; and fo many Ways only can a Line be divided harmonically in both Senfes.

AND in all that Series 'tis impossible to find any other Combination of Numbers in arithmetical Proportion, than those in the following Table; with which I have joyned their correspon-

dent Harmonicals.

| 1 | 1 | Arithmet. | | | | Harmon. | | | | | |
|---|---|-----------|---|-----|----|---------|--|----|--|----------|--|
| 1 | I | | 2 | | 31 | 2 | | 3 | | 6 | |
| I | 2 | | 3 | NI. | 4 | 3 | | 4 | | 6 | |
| J | 3 | | 4 | | 5 | 12 | | 15 | | 20 15 | |
| 1 | 4 | | 5 | 10 | 6 | IO | | 12 | | 15 | |
| | 1 | | 3 | | 5 | 3 | | 5 | | 15 | |
| | 2 | | 5 | 21. | 8 | 5 | | 8 | | 20 | |

No w, to show that there are no other Combinations to be found in the Series to anfwer the prefent Purpose,

observe, the Three arithmetical Terms must be in radical Numbers, else tho' it may be a different arithmetical Series, yet it cannot contain different Concords, so 4:6:8 is a different Series from 2:3:4, yet the geometrical Ratios, or the Concords that the Numbers of the one Series contain, being the same with these in the other, the correspondent harmonical Series gives the same Division of the Line. Now by a short and eafy Induction, I shall show the Truth of what's advanced: Look on the harmonical Series, and you fee, 1mo. That if we take the Number 1, to make an arithmetical Series of Three

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Three Terms, it can only be join'd with 2:3. or 3:5, for if you make 4 the middle Term, the other Extreme must be 7, which is not in the Series; or if you make 5 the Middle, the other Extreme is 9, which is not in the Series: Now all after 5 are even Numbers, so that if you take any of these for the middle Term, the other Extreme in arithmetical Proportion with them, must be an odd Number greater than 5, and no such is to be found in the Series: Therefore there can be no other Combination in which 1 is the lesser Extreme, but these in the Table.

2do. Take Two for the least Extreme, and the other Two Terms can only be 3:4, or 5: 8; for there is no other odd Number to take as a middle Term, but 3 or 5; and if we take 4 or any even Number, the other Extreme must be an even Number, and these Three will neceffarily reduce to fome of the Forms wherein 1 is concerned, because every even Number is divisible by 2, and 2 divided by 2 quotes 1. 3tio. Take 3 for the lesser Extreme, the other Two Terms can only be 4, 5; for if 5 is the middle Term, the other Extreme must be 7, which is not in the Series: But there are no other Numbers in the Series to be made middle Terms, 3 being the lesser Extreme, except even Numbers; and 3 being an odd Number, the other Extreme must be an odd Number too, but no fuch is to be found in the Series greater than 5. 4to. The Number 4 can only joyn with 5, 6, for all the rest are even Numbers, and where

the Three Terms are all even Numbers, they are reducible. 5to. There can be no Combination where 5 is the least Extreme, because all greater Numbers in the Series are even; for where one Extreme is odd, the other must be odd too, the middle Term being even. Lastly. All the Numbers above 5 being even, are reducible to some of the former Cases: Therefore we have found all the possible Ways any Line can be divided, that the Sections compared together and with the Whole, may be harmonical both in Quantity and Quality, as these are

explain'd.

PROBLEM VII. To divide a Line into Two Parts, equal to the Whole, fo as the Parts among themselves, and each with the Whole shall be Concord; and to discover all the possible Ways that this can be done. For the first Part the Problem, 'tis plain, that if we take Three Numbers which are all Concord among themselves, and whereof the Two least are equal to the greatest, then divide the given Line into as many Parts as that greatest Number contains Units, the Point of Division answering any of the lesser Numbers solves the Problem: So if we divide a Line AB into Three Parts, one Third AC, and Two Thirds CB, or A D and D B are the Parts fought, for all these are Concord 1:2, 2:3, 1:3. A-

I shall next shew how many different Ways this *Problem* can be folved; and I affirm, that there can be but Seven Solutions contained in

THAT these are harmonical Sections is plain,
because there are no other
Numbers here but what
belong to the harmonical
Series; and 'tis remarkable
too, that there are no other here but what belong
to the simple Concords.
But then to prove, that
there can be no other harmonical Sections, consider

| I | * | I | = | 2 |
|---|-------|---|----|--------|
| I | * | 2 | = | 3 |
| I | 4 | 3 | 17 | 4 |
| I | * | 4 | = | 5 |
| I | * | 5 | = | 6 |
| 2 | 4 | 3 | = | 5 |
| | *art. | | = | Whole. |
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that no other Number can possibly be any radical Term of a Concord, besides these of the preceeding harmonical Series. Indeed we may take any Ratio in many different Numbers, but every Ratio can have but one radical Form, and only these Numbers are barmonical; so 5: 15 is a compound 5th, yet 15 is no harmonical Number, because 5: 15 is reducible to 1:3; also 7: 14 is an Octave, yet neither 7 nor 14 are harmonical, fince they are reducible to 1:2. Now fince all the possible harmonical Ratios, in their radical Forms, are contained in the Scries, 'tis plain, that all the possible harmonical Sections of any Line or Number are to be found, by adding every Number of the Series to it felf, or every Two together, and taking these Numbers for the Two Parts, and their Sum for the whole Line. Now let us consider how many of fuch Additions will produce karmonical Se-Etions,

Etions, and what will not: It is certain, that if the Sum of any Two Numbers of the Series be a Number which is not contain'd in it, then the Division of a Line in Two Parts, which are in Proportion as these Two Numbers, can never be harmonical; for Example the Sum 3 and 4 is 7, which is not an harmonical Section, because 7 is no harmonical Number, or is not the radical Number of any harmonical Ratio. Again 'tis certain, That if any Two Numbers, with their Sum, are to be found all in the Series, thefe Numbers constitute an harmonical Section. But observe, if the Numbers taken for the Parts are reducible, they must be brought to their radical Form; for the Concords made of fuch Parts as are reducible, must necessarily be the same with these made of their radical Numbers; so if we take 4 and 6 their Sum is 10, and 4:6 are harmonical Parts of 10; but then the Case is not different from 2. 3. 5. Next, We fee that all the Numbers in that Series after the Number 5, are Compounds of the preceeding Numbers, by the continual multiplying of them by 2; therefore we can take no Two Numbers in that Series greater than 5, (for Parts) but what are reducible to 5, and some Number less, or both less; and if we take 5 or any odd Number less, and a Number greater than 5, they can never be harmonical Parts, because their Sum will be an odd Number, and all the Numbers in the Series greater than 5, are even Numbers; therefore that Sum is not in the Series; and if we take

an even Number less than 5, and a Number greater, the Sum is even and reducible; therefore all the Numbers that can possibly make the Two Parts of different harmonical Sections, are these, 1. 2. 3. 4. 5; and if we add every Two of these together, we find no other different harmonical Sections but these of the preceding Table, because their Sum is either odd or reducible; and when the Parts are equal, 'tis plain there can be but one such Section, which is 1:1:2, because all other equal Sections are reducible to this.

§ 3. Containing further Reflections upon the Division of CHORDS.

What have feen, in the last Table, that the harmonical Divisions of a Line depend upon the Numbers 2.3.4.5.6.7.8; and if we reflect upon what has been already observed of these 1.2.3.4.5.6. viz. That they are Concord, comparing every one with every other, we draw this Conclusion, That if a Line is divided into 2 or 3, 4, 5 or 6 Parts, every Section or Number of such Parts with the Whole, or one with another, is Concord; because they are all to one another as these Numbers 1.2.3.4.5.6. I shall add now, that, taking in the Number 8, it will still be true of the Series, 1.2.3.

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4. 5. 6. 8. that every Number with every other is Concord; and here we have the whole original Concords. And as to the Conclusion last drawn, it will hold of the Parts of a Line divided into 8 Parts, except the Number 7, which is Concord with none of the rest. So that we have here a Method of exhibiting in one Line all the simple and original Concords, viz. by dividing it into 8 equal Parts, and of these, taking 1. 2. 3. 4. 5. 6. and comparing them together, and with the whole 8.

But if it be required to show how a Line may be divided in the most simple Manner to exhibite all these Concords; here it is: Divide the Line AB into Two equal Parts at C; then divide the Part C B into Two equal Parts at D; and again the Part C D into Two equal Parts at E. 'Tis plain that A C or CB, are each a Half of A B; and C D or B D are each equal to a 4th Part of the Line AB; and CE or ED are A—— each an 8th Part of AB; therefore AE is equal to Five 8th Parts of AB; and AD is Six 8th Parts, or Three 4th Parts of it; and AE is therefore Five 6th Parts of AD. Again, since AD is Three 4th Parts of AB, and AC is a Half, or Two 4ths of AB, therefore AC is Two 3d Parts of AD; then, because A E is Five 8th Parts of A B, and A C Four 8ths (or a Half) therefore AC is Four 5ths of AE. Lastly, EB is Three 8ths of AB. Consequently AC to AB is an Octave; AC to AD a 5th; AD to AB, a 4th; AC

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to AE a 3d g. AE to AD a 3d l. AE to EB a 6th g. AE to AB a 6th l. which is all agreeable to what has been already elained; for AC and AB containing the therefore gives us the 5th, with the deute Term AC, and a 4th with the lower Term AB of the Octave. Again, AE is an arithmetical Mean betwixt the Extremes of the 5th AC and AD, and gives us all the rest of the Concords.

It will be worth our Pains to confider what D' Cartes observes upon this Division of a Line: But in order to the understanding what he says here, I must give you a short Account of some general Premisses he lays down in the Beginning of his Work. Says he, 'Every Sense is capable of some Pleasure, to which is required a certain Proportion of the Object to the Organ:

Which Object must fall regularly, and not very difficultly on the Senses, that we may be able to perceive every Part distinctly: Hence,

these Objects are most easily perceived, whose Difference of Parts is least, i. e. in which there

is least Difference to be observed; and therefore the Proportion of the Parts ought to be

arithmetical not geometrical; because there are fewer Things to be noticed in the arith-

metical Proportion, fince the Differences are every where equal, and fo does not weary the

Mind fo much in apprehending distinctly every Thing that is in it. He gives us this

Example: Says he, The Proportion of these Lines

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§ 3. of MUSICK. 197 Lines is easier distinguished by the Eye, than the Proportion of these va ----' because in the first we have nothing to notice but that the common Difference of the Lines 'is 1.' He makes not the Application of this expresly to the Ear, by considering the Number of Strokes or Impulses made upon it at the same Time, by Motions of various Velocities; and what Similitude that has to perceiving the Difference of Parts by the Eye: He certainly thought the Application plain; and takes it also for granted, That one Sound is to another in Tune, as the Lengths of Two Chords, cateris paribus. From these Premisses he proceeds to find the Concords in the Division of a Line, and

observes, That if it be divided into 2, 3, 4, 5, or 6 equal Parts, all the Sections are Concord; the first and best Concord Octave proceeds from dividing the Line by the first of all Numbers 2, and the next best by the next Number 3, and fo on to the Number 6. But

then, fays he, we can proceed no further, because the Weakness of our Senses cannot easily distinguish greater Differences of Sounds: But he forgot the 6th leffer, which requires a Divi-

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fion by 8, tho' he elsewhere owns it as Concord. We shall next consider what he says upon the preceeding Division of the Line A B, from

which he proposes to show how all the other Concords are contained in the Octave, and pro-

ceed from the Division of it, that their Nature may be more distinctly known. Take it in his

own Words, as near as I can translate them. First then, from the Thing premised it is certain, this Division ought to be arithmetical, " or into equal Parts, and what that is which ought to be divided is plain in the Chord AB, which is distant from A C by the Part C B; but the Sound of AB, is distant from the Sound of AC by an Octave; therefore the " Part C B shall be the Space or Interval of an " Octave: This is it therefore which ought to " be divided into Two equal Parts to have the whole Octave divided, which is done in the Point D; and that we may know what Concord is generated properly and by it felf (pro-" prie & per se, as he calls it) by this Division,
" we must consider that the Line AR which we must consider, that the Line AB, which " is the lower or graver Term of the Octave, is divided in D, not in order to it felf (non in ordine ad seipsum, I suppose he means not " in order to a Comparison of AD with AB) " for then it would be divided in C, as is al-" ready done (for AC compared to AB makes " the Octave) neither do we now divide the "Unison (viz. AB) but the Octave, (viz. the " Interval of 8ve, which is CB, as he faid alrea-" dy) which confifts of Two Terms; therefore " while the graver Term is divided, that's done in order to the acuter Term, not in order to " it felf. Hence the Concord which is properly generated by that Division, is betwixt "the Terms AC and AD, which is a 5th, "not betwixt AD, AB, which is a 4th; for the Part D B is only a Remainder, and generates

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§ 3. of MUSICK. " generates a Concord by Accident, because " that whatever Sound is Concord with one "Term of Octave, ought also to be Concord with the other." In the same Manner he argues, that the 3d g. proceeds properly, & per se out of the Division of the 5th, at the Point E, whereby we have A E a 3d g. to the acute Term of the 5th, viz. to A C (for AC to A D is 5th) and all the rest of the Concords are accidental; and thus also he makes the tonus major (of which afterwards) to proceed directly from the 3d g. and the tonus minor and Semitones to be all accidental: And to show that this is not an imaginary Thing, when he fays, the 5th and 3d g. proceed properly from the Division of Octave, and the rest by Accident, he lays, He found it by Experience in stringed Instruments, that if one String is struck, the Motion of it shakes all the Strings that are acuter by any Species of 5th or 3d g. but not these that are 4th or other Concord; which can only proceed, fays he, from the Perfection of these Concords, or the Imperfection of the other, viz. that the first are Concords per se, and the others per accidens, because they flow necessarily from them. D' Cartes seems to think it a Demon-

stration a priori from his Premisses, that if there is fuch a Thing as Concord among Sounds, it must proceed from the arithmetical Division of a Line into 2. 3, &c. Parts, and that the more

simple produce the better Concords. "Tis true, that Men must have known by Experience, that there was fuch a Thing as Concord before

they reasoned about it; but whether the general Reflection which he makes upon Nature, be sufficient to conclude that such Division must infallibly produce such Concords, I don't so clearly see; yet I must own his Reasoning is very ingenious, excepting the subtil Distinction of Concords per se of per accident, which I don't very well understand; but let every one take them as they can.



CHAP. VII.

Of HARMONY, explaining the Nature and Variety of it, as it depends upon the various Combinations of concording Sounds.

In Chap. II. § 1. I shewed you the Distinction that is made betwixt the Word Concord, which is the Agreement of Two Sounds considered either in Consonance or Succession, and Harmony, which is the Agreement of more, considered always in Consonance, and requires at least Three Sounds. In order to produce a perfect Harmony, there must be no Discord

but each must be in some Degree of Concord to all the rest. Hence Harmony is very well defined, The Sum of Concords arising from the Combination of Two or more Concords, i. e. of Three or more simple Sounds striking the Ear all together; and different Compositions of

Concords make different Harmony.

To understand the Nature, and determine the Number and Preference of Harmonies, we must consider, that in every compound Sound, where there are more than Two Simples, we have Three Things observable, 1st. The primary Relation of every simple Sound to the Fundamental (or gravest) whereby they make different Degrees of Concord with it. 2dly. The mutual Relations of the acuter Sounds each with another, whereby they mix either Concord or Discord into the Compound. 3dly. The secondary Relation of the Whole, whereby all the Terms unite their Vibrations, or coincide more or less frequently.

THE Two first of these depend upon one another, and upon them depends the last. Let us suppose Four Sounds A. B. C. D. whereof A is the gravest, B next acuter, then C; and D the acutest; A is called the Fundamental, and the Relations of B, C, and D, to A, are primary Relations: So if B is a 3d g. above A, that primary Relation is 4 to 5; and if C is 5th to A, that primary Relation is 2 to 3; and if D is 8ve to A, that is 1 to 2. Again, to find the mutual Relations of all the acute Terms

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BC,

B, C, D, we must take their primary Relations to the Fundamental, and substract each lesser from each greater, by the Rule of Substraction of Intervals; so in the preceeding Example, B to C is 5 to 6, a 3d l. B to D is 5 to 8, a 6th l. and C to D 3 to 4, a 4th. Or, if we take all the primary Relations, and reduce them to one common Fundamental, by Probl. 3. Chap. 4. we shall see all the mutual Relations in one Series; so the preceeding Example is 30. 24.

AGAIN, having the mutual Relations of each Sound to the next in any Series, we may find the primary Relations, by Addition of Intervals; and then by these all the rest of the mutual Relations; or reduce the given Relations to a continued Series by Probl. 2. Chap. 4. and then all will appear at once. Lastly, to find the secondary Relation of the Whole, find the least common Dividend to all the lesser Terms or Numbers of the primary Relations, i. e. the least Number that will be divided by each of them exactly without a Remainder; that is the Thing fought, and shows that all the fimple Sounds coincide after every fo many Vibrations of the Fundamental as that Number found expresses: So in the preceeding Example, the leffer Terms of the Three primary Relations are 4. 2. 1. whose least common Dividend is 4, therefore at every Fourth Vibration of the Fundamental the Whole will coincide; and this is what I call the secondary Relation of the Whole. I shall first show how in every Case you may find

find this least Dividend, and then explain how it expresses the Coincidence of the Whole.

PROBLEM. To find the least common Dividend to any given Numbers. Rule. 1mo. If each greater of the given Numbers is a Multiple of each leffer, then the greatest of them is the Thing fought; as in the preceeding Example. 2do. If 'tis not fo, but some of them are commenfurable together, others not; take the greatest of all that are commensurable, and, passing their aliquot Parts, multiply them together, and with the rest of the Numbers continually, the last Product is the Number fought. Example. 2. 3. 4. 6. 8. Here 2. 4. 8, are commensurable. and 8 their least Dividend; also 3. 6 commensurable and 6 their least Dividend: Then 8. 6. multiplied together produce 48, the Number fought. Take another Example. 2. 3. 5. 4. Here 2 . 4 are commensurable and all the rest incommensurable, therefore I multiply 3. 4. 5. continually, the Product is 60 the Number fought. atio. If all the Numbers are incommenfurable, multiply them all continually, and the last Product is the Answer. Example. 2. 3. 5. 7. the Product is 210. The Reason of this Rule is obvious from the Nature of Multiplication and Division.

Now I shall show that the least common Dividend to the lesser Terms of any Number of primary Relations, expresses the Vibrations of the Fundamental to every Coincidence. Thus, of the Numbers that express the Ratio of any Interval, the lesser is the Length of the acuter

Chord.

Chord, and the greater the Length of the graver: Or reciprocally, the lesser is the Number of Vibrations of the longer, and the greater the Vibrations of the shorter Chord, that are performed in the fame Time; confequently the leffer Numbers of all the primary Relations of any compound Sound, are the Numbers of the Vibrations of the common Fundamental which go to each Coincidence thereof with the feveral acute Terms; but 'tis plain if the Fundamental coincide with any acute Term after every 3 (for Example) of its own Vibrations, it will also coincide with it after every 6 or 9, or other Multiple, or Number of Vibrations which is divisible by 3, and so of any other Number; confequently the least Number which can be exactly divided by every one of the Numbers of Vibrations of the Fundamental, which go to a Coincidence with the feveral acute Terms, must be the Vibrations of that Fundamental at which every total Coincidence is performed. For Example, suppose a common Fundamental coincide with any acute Term after 2 of its own Vibrations, and with another at 3; then whatever the mutual Relation of these Two acute Terms is, it is plain they cannot both together coincide with that Fundamental, till Six Vibrations of it be finished; and at that Number precifely they must; for the Fundamental coinciding with the one at 2, and with the other at 3, must coincide with each of them at Six; and no fooner can they all coincide, because 6 is the least Multiple to both 2 and 3: Or thus, the

the Fundamental coinciding with the one after 2, must coincide with that one also after 4.6. 8. &c. still adding 2 more; and coinciding with the other after 3. must coincide with it also after 6.9.12. &c. still adding 3 more; so that they cannot all coincide till after 6. because that is the least Number which is common to both the preceding Series of Coincidences. Next for the Application of this to Harmony.

HARMONY is a compound Sound confifting (as we take it here) of Three or more simple Sounds; the proper Ingredients of it are Concords; and therefore all Discords in the primary Relations especially, and also in the mutual Relations of the several acute Terms are

absolutely forbidden.

"Tis true that Discords are used in Musick, but not for themselves simply; they are used as Means to make the Concords appear more agreeable by the Opposition; but more of this

in another Place.

Now any Number of Concords being proposed to stand in primary Relation with a common Fundamental; we discover whether or no they constitute a perfect Harmony, by sinding their mutual Relations. Example. Suppose these primary Intervals, which are Concords, viz. 3d g. 5th, 8ve, their mutual Relations are all Concord, and therefore can stand in Harmony; for the 3d g. and 5th, are to one another as 5: 6 a 3d. l. The 3d g. and Octave as 5: 8, a 6th l. the 5th and Octave are as 3: 4, a

4th; as appears in this Series to which the given Relations are reduced, viz. 30: 24: 20: 15. Aggin, take 4th, 5th, and Octave, they cannot stand together, because betwixt the 4th and 5th is a Discord, the Ratio being 8:9. Or supposing any Number of Sounds, which are Concord each to the next, from the lowest to the highest; to know if they can stand in Harmony we must find their primary Relations, and all the other mutual Relations, which must be all Concord; fo let any Number of Sounds be as 4:5:6:8 they can stand in Harmony, because each to each is Concord; but these can-

not 4. 6. 9, because 4: 9 is Discord.

WE have confidered the necessary Conditions for making Harmony, from which it will be easy to enumerate or give a general Table of all the possible Variety; but let us first examine how the Preference of Harmonies is to be determined; and here comes in the Consideration of the fecondary Relations. Now upon all the Three Things mentioned, viz. the primary, secondary, and mutual Relations, does the Perfection of Harmonies depend; fo that Regard must be had to them all in making a right Judgment: It is not the best primary Relation that makes best Harmony; for then a 4th and 5th must be better than a 4th and 6th; yet the first Two cannot stand together, because of the Discord in their mutual Relatien: Nor does the best secondary Relation carry it; for then also would a 4th and 5th, whose secondary Relation with a common Fundamental

damental is 6, be better than 3d l. and 5th, whose fecondary Relation is 10; but here also the Preference is due to the better mutual Relation of the 3d l. and 5th, which is a 3d g. and a 4th and Octave would be equal to a 6th g. and Octave, the secondary Relation of both being 3, which cannot possibly be, the Ingredients being different. As to the mutual Relations, they depend altogether upon the primary, yet not fo as that the best primary Relation shall always produce the best mutual Relation; for 'tis contrary when two Terms are joyned to a Fundamental; fo a 5th and Octave contain betwixt them a 4th; and a 4th and Octave contain a 5th. But the primary Relations are by far more considerable, and, with the fecondary, afford us the following Rule for determining the Preference of Harmony, in which that must always be taken for a necessary Condition, that there be no Discord among any of the Terms; therefore this is the Rule, that comparing Two Harmonies (which have an equal Number of Terms) that which has both the best primary and secondary Relation, is most perfect; but in Two Cafes, where the Advantage is in the primary Relations of the one, and in the secondary of the other, we have no certain Rule; the primary Relations are the principal and most considerable Things; but how the Advantage here ought to be proportioned to the Disadvantage in the secondary, or contrarily, in order to judge of the comparative Perfection, is a Thing we know not how to determine; and

208 A TREATISE CHAP. VII. and therefore a well tuned Ear must be the last Resort in these Cases.

Let us next take a View of the possible Combinations of Concords that constitute Harmony; in order to which consider, That as we distinguished Concords into simple and compound, so is Harmony distinguishable: That is simple Harmony, where there is no Concord to the Fundamental above an Octave, and it is compound, which to the simple Harmony of one Octave, adds that of another Octave. The Ingredients of simple Harmony are the 7 simple original Concords, of which there can be but 18 different Combinations that are Harmony, which I have placed in the following Table.

TABLE of HARMONIES.

| | | 2dry Rel. | | 2dry Rel. | Mark Control of the C |
|--------|------|--------------|-------------|--------------|--|
| 5th | 8ve | 2 | 3dg.5th | 4 | 3dg.5th, 8ve |
| 4th | 8ve | 3 | 3dl. 5th | IO | 3d 1. 5th, 8ve |
| 6th g. | .8ve | 3 | 4th, 6th g. | | 4th, 6th g. 8ve |
| 3d g. | 8ve | | 3dg.6thg. | | 3dg. 6th g.8ve |
| 3d l. | 8ve | 5 | 3d 1.6th 1. | | 3d 1.6th 1.8ve |
| 6th l. | 8ve | 5 | 4th, 6th 1. | 15 | 4th,6th 1. 8ve. |

I r we reflect on what has been explained of these original Concords, we see plainly that here are all the possible Combinations that make Harmony; for the Octave is composed of a 5th and 4th, or a 6th and 3d, which have a Variety of greater and lesser: Out of these are the

the first Six Harmonies composed; then the 5th being composed of 3d g, and 3d l and the 6th of 4th and 3d, from these proceed the next Six of the Table; then an Octave joyned to each of

these Six, make the last Six,

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Now the first 12 Combinations have each 2 Terms added to the Fundamental, and their Perfection is according to the Order of the Table: Of the first 6 each has an Octave; and their Preference is according to the Perfection of the other lesser Concord joyned to that Octave, as that has been already determined; and with this also agrees the Perfection of their secondary Relations. For the next 6, the Preference is given to the Two Combinations with the 5th, whereof that which hath the 3dg. is best; then to the Two Combinations with the 6th g. of which that which has the 4th is best: Then follows the Combinations with the 6th 1. where the 3d 1. is preferred to the 4th, for the great Advantage of the secondary Relation, which does more than balance the Advantage of the 4th above the 3d l. So that in these Six we have not followed the Order of the fecondary Relations, nor altogether the Order of the primary, as in the last Case. Then come in the last Place the Six Combinations arising from the Division of the Octave, into 3 Con-cords, which I have placed last, not because they are least perfect, but because they are most complex, and are the Mixtures of the other 12 one with another; and for their Perfection, they are plainly preferable to the immediately

Ingredients, and an Octave more, which does not alter the fecondary Relation, and so are equal to them in that Respect; but as they have an Octave, they are much preserable; and being compared with the first Six, they have the same Ingredients, with the Addition of one Concord more, which does indeed alter the fecondary Relations, and make the Composition more sensible, but ye adds an agreeable Sweetness, for which in some Respect they are preserable.

For compound Harmony, I shall leave you to find the Variety for your selves out of the Combinations of the simple Harmonies of several Octaves. And observe, That we may have Harmony when none of the primary Intervals are within an Octave, as if to a Fundamental be joyned a 5th above Octave, and a double Octave. Of such Harmonies the secondary Relations are ever equal to those of the simple Harmonies, whose primary Intervals have the same Denomination; and in Practice they are reckoned the same, tho' seldom are any such used.

I have brought all the Combinations of Concords into the Table of Harmony which answer to that general Character, viz. That there must be no Discord among any of the Terms; yet these sew Things must be observed. 1mo. That in Practice Discords are in some Circumstances admitted, not for themselves, simply considered, but to prepare the Mind for a greater Relish of the succeeding more perfect. Harmony. 2do. That the 4th, taken by it self, is Concord, and

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and in the next Degree to the 5th; yet in Practice 'tis reckoned a Discord when it stands next to the Fundamental; and therefore these Combinations of the preceeding Table, where it possesses that Place, are not to be admitted as Harmonies; but 'tis admitted in every other Part of the Harmony, so that the 4th is Concord or Discord, according to the Situation; for Example, if betwixt the Extremes of an Octave is . placed an arithmetical Mean, we have it divided into a 4th and a 5th 2. 3. 4. which Numbers, if we apply to the Vibrations of Chords, then the 5th is next the Fundamental, and the secondary Relation is in this Case, 2. But take an harmonical Mean, as here 3. 4. 6. and the 4th is next the Fundamental, and the fecondary Relation is 3. Now in these Two Cases, the component Parts being the same, viz. a 4th, 5th, 8ve, differing only in the Polition of the 4th and 5th, which occasions the Difference of the fecondary Relation, the different Effects can only be laid on the different Politions of the 4th and 5th; which Effect can only be meafured by the secondary Relation; and by Experience we find that the best secondary Relation makes the best Composition, so 2. 3. 4. is better than 3:4:6: And thus in all Cases, where the fame Interval is divided into the fame Parts differently fituated, the Preference will anfwer to the secondary Relation, the leffer making the best Composition, which plainly depends upon the primary Relation; but the 4th next the Fundamental is not on'y worse than the 5th

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5th, but is reckoned Discord in that Polition; and therefore all the other Combinations of the Table are preferr'd to it, or rather it is quite rejected; the Reason assigned for this is, that the graver. Sounds are the most powerful, and raise our Attention most; so that the 4th being next the Fundamental, its Imperfection compared with the Octave and 5th is made more remarkable, and confequently it must be less agreeable than when it is heard alone; whereas when it stands next the acute Term of the Octave, that Imperfection is drowned by its being between the 5th and Octave, both in primary Relation to the Fundamental. But this does not hold in the 6th and 3d, because they differ not in their Perfection fo much as the 5th and 4th. But we shall hear D' Cartes reasoning upon this. Says he, Hec infelicissima, &c. The 4th is the most unhappy of all the Concords, and never admitted in Songs, but by Accident (he means not next the Fundamental, but as it falls accidentally among the mutual Relations) not that it is more imperfect than the 3d or 6th, but because it is too near the 5th, and loses its Sweetness by this Neighbourhood; for understanding which we must notice, That a 5th is never heard, but the acuter 4th seems some way to resound, which is a Consequent of what was said before, that the Fundamental never founds but the acuter Octave feems to do fo too.

LET the Lines A C and D B be a 5th, and the Line E F, an acuter Octave to A C, it will be a 4th to DB; and if it resound to the Fun-

damental

F

damental, then, when the 5th is founded with c the Fundamental, this Resonance is a 4th above the 5th that always follows it, which is the Reason it is not admitted next the Bas; for since all the rest of the Concords in Musick are only useful for varying of the 5th, certainly the 4th which does not so is useless, which is plain from this, That if we put it next the Bass, the acuter 5th will resound, and there the Ear will observe it out of its Place, therefore the 4th would be very displeasing, as if we had the Shadow for the Substance, an Image for the real Thing. Elfewhere he fays it ferves in Composition where the same Reason occurs not, which hinders its standing next the Bass. It is well observed, that the rest of the simple Concords ferve only for varying the 5th; Variety is certainly the Life of all fenfual Pleafire, without which the more exquisite but cloy the sooner; and in Musick, were there no more Concords but Octave and 5th, it would prove a very poor Fund of Pleasure; but we have more, and agreeable to D' Cartes's Notion, we may fay, They are all designed to vary the 5th, for they all proceed from it, as we faw in the Divisions of the upper and lower 5th of the Octave in Chap. 5. and that all the Variety in Musick proceeds from these 3 ds and 6ths arising from the Division of the 5th directly or accidentally, as we shall fee more particularly afterwards: Mean time observe, that as the 4th rises naturally from the Division of the Octave, so it ferves

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ferves to vary it, and accordingly is admitted in Composition in every Part but next the Fundamental or Bass; for the 5th being more perfect and capable of Variety (which the 4th is not, fince no lesser Concord agrees to both its Extremes) by Means of the 3ds, ought to stand next the Fundamental. Now if the 4th must not stand with the Fundamental, then this 4th, with the Octave, must not be reckoned among simple Harmonies. To prove that the 4th considered by it self is a Concord, Kircher makes a very odd Argument. Says he, A 4th added to a 5th makes an Octave, which is Concord; but nothing gives what it has not, therefore the 4th is a Concord: But by the same Argument you may prove that any Interval less than Octave is a Concord.

I have observed of the Series 1, 2, 3, 4, 5, 6, 8 that they are Concords each with other. They contain all the original Concords, and the chief of the compound; and they stand in such Order that Seven Sounds in the Proportions and Order of this Series joyned in one Harmony is the most complete and perfect that can be heard; For here we have the chief and principal of all the Harmonies of the preceeding Table, as you'll see by comparing these Numbers with that Table; so that in this short and simple Series we have the whole essential Principles and Ingredients of Musick; and all at once the most agreeable Essect that Sounds in Consonance can

have,

LET us now consider how these Sounds may be raised; this will be easily found from the Things already explained; but we must first obferve, that there will be a great Difference betwixt applying these Numbers to the Lengths of Chords, and to their Vibrations: If they are applied to the Chords, then 'tis eafy to find Seven Chords which shall be as these Seven Numbers; but 8 being the longest Chord, the less perfect Concords stand in primary Relation to the Fundamental; and the fecondary Relation is 15: But if we have Seven Sounds whose Vibrations are as these Numbers, then I is the Vibration of the Fundamental, and fo on in Order to 8 the Vibration of the acutest performed in the fame Time: And thus the best Concords stand in primary Relation to the Fundamental, and I is the secondary Relation: Therefore to afford this most perfect Harmony, we must find Seven Sounds which from the lowest to the highest shall be as 1:2:3:4:5:6:8, the least Number representing the gravest Sound. Now, to do this, let us mind that the Lengths of Chords are in simple reciprocal Proportion of their Vibrations accomplished in the same Time, out of which I shall draw the Two following Problems, whereof the first shall solve the Question in hand.

PROBLEM I. To find the Lengths of feveral Chords, whose Vibrations performed in the same Time, shall be as a given Rank of Numbers. Rule. Take the given Series, and out of it find another reciprocal to it, by Theor. 14.

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Chap. 4. which, according to the Demonstration there given, and what I have premised here, is the Series of Lengths sought, so the preceeding Series 1. 2. 3. 4. 5. 6. 8. being given as a Series of Vibrations performed in the same Time, the Lengths of Seven Chords, to which that Series of Vibrations agrees, are 120,60.40. 30. 24. 20. 15. And these Seven Chords being in every other Respect equal and alike, and all founded together, shall produce the Harmony required.

PROBLEM II. The Lengths of several Chords being given, to find the Number of Vibrations of each performed in the same Time. This is done the same Way as the former: And so if the Series 1. 2. 3. 4. 5. 6. 8. &c. be the Length of Seven Chords, their Vibrations sought are

120. 60. 40. 30. 24. 20. 15.

Note. From what has been explained in Theor. 14. Chap. 4. we fee that if one of thefe, viz. the Lengths of feveral Chords, or their Vibrations accomplished in the same Time, make a continued arithmetical or harmonical Series, the other will be reciprocally an harmonical or arithmetical Series, fo the preceeding Series 1. 2. 3. 4. 5. 6. being continuedly arithmetical, its correspondent Series 120, 60, 40, 30, 24, 20, is continuedly harmonical; but the Number 8 in the first Series interrupts the arithmetical Proportion, and so is the harmonical Proportion interrupted by its Correspondent 15. But as in the first, 2. 4. 6. 8. are continuedly arithmetical, fo are these correspondent to them in the other barmoharmonical, viz. 60: 30: 20: 15. Also it will hold universally, that taking any Numbers out of the one Series in continued arithmetical or harmonical Proportion, their Correspondents in the other will be reciprocally harmonical or arithmetical.

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CHAP. VIII.

Of concinnous Intervals, and the Scale of Musick.

Mind of Man is delicated with the

§ 1. Of the Necessity and Use of concinnous Difcords, and of their Original and Dependence on the Concords.

E have, in the preceeding Chapters, considered the first and most essential Principles [as far as concerns the first Part of the Definition] of Musick, viz. these Relations of Sound in Acuteness and Gravity whose Extremes are Concord; for without these there can be no Musick: The indefinite Number of other Ratios being all Discord, belong not essentially to Musick, because of themselves

Chap. 4. which, according to the Demonstration there given, and what I have premised here, is the Series of Lengths sought, so the preceeding Series 1. 2. 3. 4. 5. 6. 8. being given as a Series of Vibrations performed in the same Time, the Lengths of Seven Chords, to which that Series of Vibrations agrees, are 120, 60. 40. 30. 24. 20. 15. And these Seven Chords being in every other Respect equal and alike, and all founded together, shall produce the Harmony required.

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Of concinnous Intervals, and the Scale of Musick.

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felves they produce no Pleasure; yet some of them are admitted into the System as necessary to the better being of it, both with respect to Consonance and Succession, but most remarkably in this; and succession are called inconcinnous. To explain what these concinnous Intervals are, their Number, Nature and Office, shall employ this Chapter.

In order to which, I shall first offer the following Considerations, to prove that some other than the harmonical Intervals of Sound (i. e. such whose Extremes are Concord) are necessary for the Improvement or better Being

of Musick.

We know by Experience how much the Mind of Man is delighted with Variety: It can stand no Dispute, whether we consider intellectual or sensible Pleasures; every one will be conscious of it to himself: If you ask the Reason, I can only answer, That we are made so: And if we apply this Rule to Masick, then it is plain the more Variety there is in it, it will be the more entertaining, unless it proceed to an Excess; for so similar are our Capacities, that too much or too little are equally satal to our Pleasures. Let us then consider what must be the Effect of having no other but harmonical Intervals in the System of Musick, and,

First, With respect to a single Voice, if that should move always from one Degree of Tune to another, so as every Note or Sound to the

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next were in the Ratio of some Concord, the Variety which we happily know to be the Life of Musick would soon be exhausted. For to move by no other than barmonical Intervals, would not only want Variety, and fo weary us with a tedious Repetition of the same Things; but the very Perfection of fuch Relations of Sounds would cloy the Ear, in the same Manner as fweet and luccious Things do the Tafte, which are therefore artfully feafoned with the Mixture of fowr and bitter: And fo in Mufick the Perfection of the barmonical Intervals are fet off, and as 'twere feafoned with other Kinds of Intervals that are never agreeable by themselves, but only in order to make the Agreement of the other more various and remarkable. D' Cartes has a Notion here that's worth our considering. He observes, that an acute Sound requires a greater Force to produce it either in the Motion of the vocal Organs of an Animal, or in striking a String; which we know by Experience, fays he, in Strings, for the more they are stretched they become the acuter, and require the greater Force to move them: And hence he concludes, that acute Sounds, or the Motion of the Air that produce them immediately, strike the Ear with more Force: From which Observations he thinks may be drawn the true and primary Reason why Degrees (which are Intervals less than any Concord) were invented; which Reason he judges to be this, Left if the Voice did always proceed by barmonical Distances, there should be too great Disproportion

tion or Inequality in the Intenseness of it (by which Intenseness he plainly means that Force with which it is produced, and with which also it strikes the Ear) which would weary both Singer and Hearer. For Example. Let A and B be at the Distance of a greater 3d, if one would ascend from A to B, then because B being acuter strikes the Ear with more Force than A; lest that Disproportion should prove uneafy, another Sound C is put between them, by which as by a Step we may afcend more easily, and with less unequal Force in raifing the Voice. Hence it appears, fays he, that the Degrees are nothing but a certain Medium contrived to be put betwixt the Extremes of the Concords, for moderating their Inequality, but of themselves they have not Sweetness enough to fatisfy the Ear, and are of Use only with regard to the Concords; fo that when the Voice has moved one Degree, the Ear is not yet fatisfied till we come to another, which therefore must be Concord with the first Sound. Thus far D' Cartes reasons on this Matter; the Substance of what he says being plainly this, viz. That by a fit Division of the concording Intervals into lesser Ones, the Voice will pass smoothly from one Note to another, and the Hearer be prepared for a more exquisite Relish of the perfecter Intervals, whose Extremes are the proper Points in which the Ear finds the expected Rest and Pleasure. Yet moving by harmonical Distances is also necessary, but not so frequently: The Thing therefore required as ta

to this Part is, fuch Intervals less than any harmonical one, which shall divide these, in order that the Movement of a Sound from their one Extreme to another, by these Degrees, may be smooth and agreeable; and by the Variety improve the more essential Principles of Musick to a Capacity of affording greater Pleasure, and

all together make a more perfect System.

2dly. LET us consider Musick in Parts, i.e. when Two or more Voices joyn in Confonance; the general Rule is, That the fuccessive Sounds of each be fo ordered, that the feveral Voices shall always be Concord. Now there ought to be a Variety in the Choice of these successive Concords, and also in the Method of their Successions; but all this depends upon the Movements of the fingle Parts. And if these could move in an agreeable Manner only by harmo-nical Distances, there are but a few different Ways in which they could remove from Concord to Concord; and hereby we should lose very much of the Ravisament of Sounds in Confonance. As to this Part then, the Thing demanded is, a Variety of Ways, whereby each fingle Voice of more in Confonance may move agreeably in their successive Sounds, so as to pass from Concord to Concord, and meet at every Note in the same or a different Concord from what they stood at in the last Note. what Cases and for what Reasons Discords are allowed, the Rules of Composition must teach: But joyn these Two Considerations, and you see manifestly how imperfect Mufick would be without out any other Intervals than Contords; the these are the principal and most essential, and the others we now enquire into but subservient to them, for varying and illustrating the Pleasure that arises immediately out of the harmonical Kind.

But, lastly, consider, that the Melody of a single Voice is very agreeable, yet no Confonance of Parts can have a good Effect separately from the other; therefore the Degrees which answer the first Demand, must serve the other too, else, however perfect the System be as to the first Case, it will be still imperfect as to the last.

WHEN a Question is about the Agreeableness of any Thing to the Senses, the last Appeal must be to Experience, the only infallible Judge in these Cases; and so in Musick the Ear must inform us of what is good and bad; and nothing ought to be received without its Approbation. We have feen to what Purpofes other Intervals than the harmonical are necesfary; now we shall fee what they are; and agreeable to what has been faid, we shall make Experience the Judge, which approves of those, and those only, with their Dependents (besides the harmonical Intervals) as Parts of the true natural System of Musick, viz. whose Ratios are 8:9. called a greater Tone, 9:10 called a leffer Tone, and 15: 16 called a Semitone: And these are the lesser Intervals, particularly called Degrees, by which a Sound can move upwards or downwards fuccessively, from one Extreme

treme of any barmonical Interval to another. and produce true Melody; and by Means whereof also several Voices are capable of the necessary Variety in passing from Concord to Concord. By the Dependents of these Degrees, I mean their Compounds with Octave, (which are understood to be the same Thing in Practice, as we observed in another Place of compound Concords) and their Complements to an Octave (or Differences from it) viz. 9: 16, 5:9, 8: 15, which are also a Part of the System, tho' more imperfect, but of these afterwards: As to the Semitone, 'tis fo called, not that it is geometrically the Half of either of these which we call Tones (for 'tis greater) but because it comes near to it; and 'tis called the greater Semitone, being greater than what it wants of a Tone.

NOTE, Hitherto we have used the Words, Tone and Tune indifferently, to signify a certain Quality of a single Sound; but here Tone is a certain Interval, and shall hereafter be constantly so used, and the Word Tune always ap-

plied to the other.

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Our next Work shall be to explain the O-riginal of these Degrees, and their different Pertections; and then shew how they answer the Purposes for which they were required; and, in doing this, I shall make such Resections upon the Connection and Dependence of the several Parts of the System, that we may be confirmed both by Sense and Reason in the true Principles of Musick.

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As to the Original of these Degrees, they arise out of the simple Concords, and are equal to their Differences, which we take by Probl. 10. Chap. 4. Thus 8:9 is the Difference of a 5th and 4th. 9:10 is the Difference of a 3d 1. and 4th, or of 5th and 6th g. 15:16, the Difference of 3d g. and 4th, or of 5th and 6th l.

We shall presently see the Reason why no other Degrees than such as are the Differences of Concords could be admitted; but there are other Differences among the simple Concords, besides these (which you may observe do all arise from a Comparison of the 5th with the other Concords) yet none else could answer the Design, which I shall shew immediately, and give you in the mean Time a Table of all these Differences of simple Concords, which are not Concords themselves.

| Differences of | Ratios. | Thall |
|-----------------------------|--------------------------------------|--------------------------------------|
| 3d 1. and { 3d g. 4th 6th g | = 24 : 25 = 9 : 10 [= 18 : 25 | now ex- plain how these De- |
| 3d g. and { 4th 6th 1. | = 15:16 = 25:32 | grees con- tribute to the Ini- |
| 4th and 5th | * 8:9 | of the Sy- |
| 5th and \ \ 6th \ 6th \ g | = 15:16 | ftem of, Musick: |
| 6th 1. and 6th g | . = 24 : 25 | In doing which I shall |

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shall endeavour to give the Reason why these

only are proper and natural to that End.

Degrees were required both for improving the Melody of a fingle Voice confidered by it felf; and that feveral Voices, while they move melodiously each by it felf, might also joyn together in an agreeable Variety of Harmony; and therefore I observed, that the Degrees required must answer both these Ends, if possible; accordingly, Nature has bounteously afforded us these necessary Materials of our Pleasure, and made the preceeding Degrees answer all our

Wish, as I shall now explain.

I shall first consider it with respect to the Consonance of Two or more Voices. Suppose Two Voices A and B, containing between them any Conwrd; they can change into another Concord only Two Ways. 1mo. If the one Voice as A keeps its Place, and the other B moves upward or downward (i. e. becomes either acuter or graver than it was before.) Now if the Movement of B can only be agreeable by harmonical Intervals, they can change only in these Cases, viz. if the first Concord be Octave, then by B's moving nearer the Pitch of A, either by the Distance of a 6th, 5th, 4th or 3d, the Two Voices will concord in a 3d, 4th, 5th or 6th, which is plain from the Composition of an Oclave: And confequently by B's moving farther from A, the Voices can again change from any of these lesser Concords to an Octave. Or inppose them at first at a 6th, by B's moving either a 4th or 3d, they will meet in a 3d or

4th, or being at a 4th or 3d, they may meet in a 6th, because a 6th is composed of 4th and 3d. And lastly, being at a 5th, they may meet in a 3d, and contrarily. But by the Use of these Degrees the Variety is increased; for now suppose A and B distant by any simple Concord, if B moves up or down one of these Degrees 8:9, or 9:10, or 15:16, there shall always be a Change into some other Concord, because these Degrees are the very Differences of Concords. Then, 2do. If we suppose both the Voices to move, they may move either the fame Way (i. e. both become acuter or graver than they were) or move contrary to one another; and in both Cases they may increase their first Distance, or contract it, so as to meet in a different Concord; but then if the Movements be by harmonical Intervals, the Variety will be far less here than in the first Supposition; but this is abundantly supplied by the Use of the Degrees. You must observe again, that besides the Want of Variety in most of the Changes that can be made, from Concord to Concord, by the fingle Voices moving in harmonical Distances, there will be too great a Disproportion or Inequality of the Concord you pass from, and that you meet in, which must have an ill Effect: For by Experience we are taught, that Nature is best pleased, where the Variety and Changes of our Pleasure (arising from the same Objects) are gradual and by smooth Steps; and therefore moving from one Extreme to another is to be feldom practis'd; for this Reason also the

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the Degrees are of necessary Use for making the Passage of the Concords easy and smooth, which generally ought to be from one Concord into the next, which is consistent with the Motion of one or both Voices. But let me make this last Remark, which we have also confirmed from Experience, viz. That of Two Sounds in Consonance, 'tis required not only that every Note they make together be Concord (I have faid already that there are fome Exceptions to this Rule) but that, as much as possible, the present Note of the one Voice be Concord to the immediately preceeding Note of the other; which can be done by no Means fo well as by fuch Degrees as are the Differences of Concords (where these happen to be Difcord, Musicians call it particularly Relation in harmonical.) And indeed upon this Principle it can easily be shewn, that 'tis impossible there can be any other Degrees admitted, than what are equal to the Differences of simple Concords: If only one Voice move, the Thing is plain; if both move, let us suppose A B at any Concord, and to move into another, and there let the Two new Notes be expressed by a b. Then fince a B must be Concord, it follows, that the Distance of a and A is equal to the Difference of the Two Concords AB, and aB; the same Way 'tis proven that b B is the Difference of the Concords A B, and b A.

"Trs a very obvious Question here, why the fuccessive Notes of Two different Voices may not as well admit of Discords, as these of the

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fame Voice; to which the Answer seems plainly to be this, that in the same Voice, the Degrees, which are the only Discords admitted, are regulated by the harmonical Intervals to which they are but subservient; and the Melody is conducted altogether with respect to these; for the Degrees of themselves without their Subserviency to the Concords could make no Musick, as shall be further explained afterwards: But in the other Case, the successive Motions can be brought under no fuch Regulation, and therefore must be harmonical as much as posfible, lest it diminish the Pleasure of the succeeding Concord; besides, consider the Discords that are most ready to occur here, are greater than the Degrees, and would be intolerable in any Cafe.

But now, supposing that only these Discords belong to the System of Musick, which are the Disserences of Concords, you'll ask why the other Disserences marked in the preceding Table are excluded, viz. 24: 25 the Disserence of the Two 3ds, or the Two 6ths; 18: 25 the Disserence of the 3d l. and 6th g. 25: 32 the Disserence of 3d g. and 6th l. To satisfie this, we are to consider, First, that the Passage of several Voices from Concord to Concord does not need them, there being a sufficient Variety from the other Disserences; but chiefly the Reason seems to be, that they don't answer the Demands of a single Voice, which I shall explain in the next 9, and desire you here only to observe

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ferve that they arise out of the impersect Concords, viz, 3ds and 6ths.

§ 2. Of the Use of Degrees in the Construction of the Scale of Musick.

7 E have already observed, that the Concords are the effential Principles of Musick as they afford Pleasure immediately and of themselves: Other Relations belong to Mufick only as they are subservient to these. We have also explained what that Subserviency required is, viz. That by a fit Division of the harmonical Intervals a fingle Voice may pass fmoothly from one Extreme to another, whereby the Pleasure of these perfect Relations may be heightned, and we may have a Variety necessary to our more agreeable Entertainment: It follows, that to answer this End, the Intervals fought, or fome of them at least, must be less than any harmonical one, i. e. less than a 3d l. 5: 6; and that they ought all to be less, will prefently appear from the Nature of the Thing. For the Degrees fought we have already affigned these, viz. 8:9 called a greater Tone, 9: 10 called a lesser Tone, and 15: 16 called a greater Semitone: Now that every barmonical Interval is composed of, and consequently refolvable into a certain Number of these Degrees, will appear from the following Table, 230 A TREATISE CHAP. VIII.

Table, wherein I give you the Number and Kinds of these Degrees that each Concord is equal to, which you can prove by the Addition of Intervals, Chap. 4. Or you'll find it more easily afterwards, when you see them all stand in order in the Scale; we shall afterwards consider in what Order these Degrees ought to be taken in the Division of any Interval.

| | | | | | | and and | |
|----|------------|--------------|----|-----|---------|---------|-------|
| - | TAB Par | LE ts. of | 0/ | one | be cord | ompo | onent |
| | 3d 1. | | | | & t | | |
| | 3d g. | | | g, | - 2 - 2 | tl, | |
| | 4th | onta | t | g, | I | tl, | I f |
| 21 | 5th | | t | g | I | tl, | I f |
| | 6th l. | ns | | g, | | tl, | 2 5 |
| - | 6th g. | | | g, | | tl, | I J |
| - | 8ve | | t | g, | 2 | tl, | 2 5 |
| | | | | | | | |

NOTE,
That as in
this Table, so
afterwards I
shall for Brevity mark a
greater Tone
thus t g, a
leffer thus t l,
a Semitone
thus s.

But now, observe, that since we can conceive a Variety of other Intervals that will divide the Concords besides these, we are therefore to consider for what Reason they are preferable to any other: To do this, I shall first shew you, that no other but such as are equal to the Differences of Concords are sit for the Purpose, and then for what Reason only these Three are chosen.

For the First, consider, that every greater Concord contains all the lesser within it, in such a Manner, that betwixt the Extremes of any greater Concord, as many middle Terms may

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be placed as there are lesser Concords; which middle Terms shall be to any one Extreme of that greater Concord in the Ratio of these lesser Concords; so betwixt the Extremes of the 8ve may be placed 6 Terms, which shall make all the lesser Concords with any one of the Extremes, as in this Series,

$$\mathbf{I} : \frac{5}{6} : \frac{4}{5} : \frac{3}{4} : \frac{2}{3} : \frac{5}{8} : \frac{3}{5} : \frac{1}{2}$$

where comparing each Term with 1, you have all the fimple Concords in their gradual Order, 3d 1. 3d g. 4th, 5th, 6th 1. 6th g. 8ve; and the mutual Relations of the Terms immediately next other in the Series are plainly the Differences of the Concords which thefe Terms make with the Extreme. Now it is natural and reasonable that if we would pass by Degrees from one Extreme to another of any greater harmonical Interval, in the most agreeable Manner, we ought to choose such middle Terms as have an harmonical Relation to the Extremes of that greater, rather than fuch as are Discord; for the simple Concords being different in Perfection, vary the Pleasure in this Progression very agreeably; but we could not bear to hear a great many Sounds fucceeding one another, among which there were no Concord, or where only the last is concord to the First: And therefore it is plain that the Degrees required ought to be equal to the Differences of Concords, as you fee evidently they must be where the middle Terms are Concord with

with one or both the Extremes. But of all the discord Differences of Concords, only these are agreeable, viz. 8:9, 9:10, 15:16; the other Three are rejected, viz. 24:25, 18:25, 25: 32; the Reason of which seems to be, that the Two last are too great, and the first too fmall; but particularly 25: 32 is an Interval greater than a 4th, as 18: 25 is greater than a ad g. and therefore would make fuch a difproportioned and unequal Mixture with the other Degrees, that would be infufferable. Then for 24: 25 it is too small, and would also make too much Inequality among the Degrees. But at last we shall take Experience for the infallible Proof that we have chosen the only proper Degrees: Our Reason in Cases like this can go no further than the making fuch Observations upon the Dependence and Connection of Things, that from the Order and Analogy of Nature we may draw a probable Conclusion that we have discovered the true natural Rule. And of this Kind we shall immediately have further Demonstrations that the only true natural Degrees are these already affign'd.

We come now to consider the Order in which the Degrees ought to be taken, in this Division of the harmonical Intervals, for constituting the Scale of Musick; for the we have the true Degrees, yet it is not every Order and Progression of them that will produce true Melody. For Example, The the greater Tone 8:9 be a true Degree, yet there could be no Musick made of any Number of such Degrees, because no Num-

ber of them is equal to any Concord; the same is true of the other Two Degrees; which you may prove by adding Two or Three, &c. of any one Kind of them together, till you find the Sum exceed an Octave, which it will do in 6 greater Tones, or 7 lesser Tones, or 18 Semitones; and compare the Sum of 2, 3, 4, &c. of them, till you come to that Number, you'll find them equal to no Concord. Therefore there is a Necessity that these Degrees be mixt together to make right Musick; and 'tis plain they must be so mixt, that there ought never to be Two of one Kind next other. But this we shall have also confirmed in examining the Order they ought to be taken in.

THE Octave containing in it all the other simple Concords, and the Degrees being the Differences of these Concords, it is plain that the Division of the Octave will comprehend the Divisions of all the rest: Let us therefore joyn all the simple Concords to a common Funda-

mental, and we have this Series.

$$I: \frac{5}{6}: \frac{4}{5}: \frac{3}{4}: \frac{2}{3}: \frac{5}{8}: \frac{3}{5}: \frac{1}{2}$$
Fund. 3d l. 3dg. 4th, 5th 6th l. 6th g. 8ve.

Now if we should ascend to an Octave by these Steps, 'tis evident we have all the possible harmonical Relations to the Fundamental; and if we examine what Degrees are in this Afcent

234 A TREATISE CHAP. VIII. fcent, or the mutual Relations of each Term to the next, they are these.

But this we know is far from being a melodious Afcent; there is too great Inequality among these Degrees; the first and last are each a 3d 1. which ought also to be divided; it is equal to a tg. and s. and so instead of & we shall have these Two Degrees 8:9 and 15:16. But when this is done, yet the Division of the O-Have will not be perfect; for we have too many Degrees, and an Excess is as much a Fault as a Defect : So many fmall Degrees would neither be easily raised, nor heard with Pleasure: The Two 3ds and Two 6ths have fo small a Difference, 24: 25, that the Division of the O-Etave does not require nor admit them both together, the Progress being smoother where we have but one of the 3ds and one of the 6th? If this Degree 24:25 be expelled, then will 9: 10 have Place in the Series, which is not only a better Relation of it felf, as it confifts of lesser Numbers, but it has a nearer Affinity with the other Two 3:9 and 15:16, all these Three proceeding from the 5th, as I have already noted.

Now then if we take only one of the 3ds and one 6th in the Division of the 8ve we have these Two different Series.

Fund. 3dl. 4th, 5th, 6thl. 8ve $I \cdot \frac{5}{6} \cdot \frac{3}{4} \cdot \frac{2}{3} \cdot \frac{5}{8} \cdot \frac{1}{2}$ and 6th 1. are $1 \cdot \frac{4}{5} \cdot \frac{3}{4} \cdot \frac{2}{3} \cdot \frac{3}{5} \cdot \frac{1}{2}$ Fund. 3dg. 4th, 5th, 6th g.8ve cause their Re-

THE 3d 1. taken together, as the 3d g. and 6th g. belation is the

Concord of a 4th; whereas the 3d l. and 6th g. also the 3d g. and 6th 1. are one to the other a gross Discord; and 'tis better how many Concords are among the middle Terms; but if in some particular Cases of Practice this Order is changed, 'tis done for the fake of some other Advantage to the Melody, of which I have an Occasion to speak afterwards. But the 3ds next each Extreme are yet undivided, which ought to be done to complete the Division of the Octave.

In the first of the preceeding Series we have the 3d l. next the Fundamental, and the 3d g. next the other Extreme: In the Second we have the 3d g. next the Fundamental, and the 3d 1. next the acute Extreme. Now it is plain what Degrees will divide these 3ds, because we fee them divided in the Divisions already made; for in the first Series, betwixt the 3d 1. and the 5th we have a 3d g. (which is their Difference) divided into these Degrees, and in this Order afcending, viz. tl. and tg. and betwixt the 4th and 6th l. we have a 3d l. (which is their Dif-

Difference) divided into t g. and f. We have the same Intervals divided in the other Series betwixt the 3d g. and 5th, and betwixt the 4th and 6th g. but the Order of the Degrees here is reverse of what it is in the other Series: And the Question now is, what is the most natural Order for the Division of these 3ds that ly next the Extremes in the Q-Etaves? It may at first seem that we have got a fair and natural Hint from these Places mentioned, and that the 3ds ought to be ordered the same Way towards the Extremes of each Series, as they are in these Places of it. In the 3ds next the Fundamental I have followed that Order, but not for that Reason; and in the upper 3ds I have taken the contrary Order, which fee in the Two following Series, where I have marked the Degrees from every Term to the next; and you fee I have divided

with a 3d l. -
$$\mathbf{I}$$
: $\frac{8}{9}$: $\frac{5}{6}$: $\frac{3}{4}$: $\frac{2}{3}$: $\frac{5}{8}$: $\frac{5}{9}$: $\frac{1}{2}$

tg. f . tl. tg. f . tg. tl.

with a 3d g. - \mathbf{I} : $\frac{8}{9}$: $\frac{4}{5}$: $\frac{3}{4}$: $\frac{2}{3}$: $\frac{3}{5}$: $\frac{8}{15}$: $\frac{1}{2}$

tg. tl. f . tg. tl. tg. f .

the 3d g. (which is in the upper Place of the one and lower of the other Series) in this Order ascending, viz. t g. and t l. And the 3d l. (which is also in the upper Place of theone and

and lower of the other) in this Order ascending, viz. t g. and f. The Reason of this Choice I shall thus account for. First, As to the 3d next the Fundamental, I place the t g. lowest, because it is the Degree which a natural Voice can most easily raise, being the most perfect of the Three, and we find it fo by Experience; and if you consider, that it is the Difference of a 4th and 5th, which two Concords the Ear is perfectly Judge of, by practifing thefe one learns very eafily how to raife a t g. with Exactness: But for the tl. (the other Part of the 3d g.) it is not fo easily learned, for the Difference betwixt the Two Tones being but fmall, one cannot be fure of it, but will readily fall into the more perfect. It is true, that in rising from any Fundamental to a 3d g. we take a t l. at the second Step; but then I believe, our taking it exactly here, is owing to the Idea of the Fundamental, to which the Ear feeks the harmonical Relation of 3d g. where it rests with Pleasure; and whenever a Reason like this occurs, the Voice will easily take a t l. even at the first Step; for Example, Suppose Two Voices concording in a 6th g. if one of them keeps its Tune, and the other moves to meet it in a 5th, then must that Movement be a t 1. which is the Difference of 6th g. and 5th: As to the Parts of the 3d l. observe, that the t g. and f. being remarkably different, there would be no Hazard of taking the one for the other; therefore as to that, any of them might stand next the Fundamental, yet the tg. being a more more perfect Relation, it is easier taken, and makes a more agreeable Afcent, tho' I know that in some Circumstances the f. is placed next the Fundamental (as I shall mark in its proper Place.) Now for the Degrees of the upper Third, the t g. is fet in the lowest Place in both the Series; the Effect of which is, that the middle Term proceeding from that Order, is in an harmonical Relation to more, and the more principal of the other Terms in the Series. Kepler upon harmonical Proportions places the t g. next both the Extremes in the O-Etave, and gives this Reason for it, lest the second and feventh Term of the one Series differ from these in the other (for it seems he would have them differ as little as possible, viz. only in the 3ds and 6ths) and this he concludes with a Kind of Triumph against the Authorities of Ptolomy, Galileus and Zarline, whom he mentions as contrary to him in this Point. But indeed I cannot fee the Sufficiency of this Reason, there is nothing in it drawn from the Nature of the Thing: And as to 3d in the upper Place, the Order in which I've placed its Degrees, is approven by Experience, and is I think the constant Practice.

Thus we have the Octave completely divided into all its concinnous Degrees, and in it the Division of all the lesser Concords, with the most natural and agreeable Order in which these Degrees can follow, in moving from any given Sound through any harmonical Interval. There are only these Three different

Degrees, viz. t g. 8: 9, t l. 5: 6, and f. 15: 16. And how many of each Kind every harmonical Interval contains, is to be seen in the preceeding Series, which easily confirms and proves the Table of Degrees given a little above, where you see also the natural Order, viz. in ascending, it is t g. t l. f. t g. t l. t g. f. --- Or this, <math>t g. f. t l. t g. f. t g. t l. according as you chose the <math>3d l. or 3d g. to ascend by; and in descending we take that Order just reverse, by taking the same individual middle Terms.

Now the System of Octave containing all the original Concords, and the compound Concords being the Sum of Octave and fome leffer Concord, therefore 'tis plain, that if we would have a Series of Degrees to reach beyond an Octave, we ought to continue them in the same Order thro' a second Octave as in the first, and so on thro a third and fourth Octave, &c. and fuch a Series is called The Scale of Musick, which as I have already defin'd, expresses a Series of Sounds, rising or falling towards Acuteness or Gravity, from any given Pitch of Tune, to the greatest Distance that is sit or practicable, thro' such intermediate Degrees as makes the Succession most agreeable and perfect; and in which we have all the harmonical Intervals most concinnously divided. And of this we have Two different Species according as the 3d l. or 3d g. and 6th l. or 6th g. are taken in, which cannot both stand together in relation to one Fundamental, and make an harmonical

monical Scale. But if either of these Ways we afcend from a Fundamental or given Sound to an Octave, the Succession is very melodious, tho' they make different Species of Melody. It is true, that every Note to the next is Discord, but each of them is Concord with the Fundamental, except the 2d and 7th, and many of them among themselves, which is the Ground of that Agreeableness in the Succession; for we must reflect upon what I have elsewhere observed, that the graver Sounds are the more powerful, and are capable of exciting Motion and Sound in Bodies whose Tune is acuter in a Relation of Concord, particularly 8ve and 5th, which an acute Sound will not effect with refpect to a grave. And this accounts for that Maxim in Practice, That all Musick is counted upwards; the Meaning is, that in the Conduct of a fuccessive Series of Sounds, the lower or graver Notes influence and regulate the acuter, in fuch a Manner that all these are chosen with respect to some fundamental Note which is called the Key; but of this only in general here, in another Place it shall be more particularly confidered.

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We have exprest the several Terms of the Scale by the proportional Sections of a Line represented by 1, which is the Fundamental of the Series; but if we would express it in whole Numbers, it is to be done by the Rules of Chapter and the Series, in each of which the greatest Number expresses

expresses the longest Chord, and the other Numbers the rest in Order.

540: 480: 432: 405: 360: 324: 288: 270 tg. tl. f. tg. tl. tg. f.

216: 192: 180: 162: 144: 135: 120: 108 tg. f. tl. tg. f. tg. tl.

THE first Series proceeds by a 3d g. and the other by a 3d l. and if any Number of Chords are in these Proportions of Length, cateris paribus, they will express the true Degrees and Intervals of the System of Musick, as 'tis contain'd in an 8ve concinnously divided in the Two different Species mentioned.

S. Containing further Reflections upon the Constitution of the Scale of Musick; and explaining the Names of 8ve, 5th, &c. which have been hitherto used without knowing all their Meaning; shewing also the proper Office of the Scale.

WTE considered in Chapter 5. the Division of the Concords, in order only to find what Intervals they were immediately divisible into: We find that either an harmonical or withmetical Mean divides the 8ve into a 5th

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and 4th, with this Difference, that the harmonical puts the 5th, and the arithmetical the 4th next the Fundamental: And from this the Invention of the tg (which is the Difference of 4th and 5th) was very obvious. These Divisions of the 8ve we suppose indeed made only for difcovering the immediate harmonical Parts of it; but taking in both these middle Terms, then we fee the 8ve resolved into these Three Parts, and in this Order, viz. a 4th, a tg and a 4th, as in these Numbers 6:8:9:12. where 6 and 12 are 8ve; 8 is an karmonical Mean, and 9 an arithmetical Mean; 6:8 is a 4th; 8:9 a tg. and 9:12 a 4th; that these Two middle Terms are at a Distance proper for making Melody, and confequently that their Relation 8:9 is a concinnous Interval, we have infallible Affurance of from Experience.

But I proposed to make some Observations on the Connection and Dependence of the fevetal Parts of the System of Musick; and First, we are to remark, that this Degree 8:9 proceeds from the Two Concords that are of the next perfect Form to 8ve, viz. 4th and 5th, which are the harmonical Parts of it; and stands so in the middle betwixt the upper and lower 4th, that added to either of them it makes up the 5th, and so joyns the harmonical and arithmetical Division of 8ve in one Series: and this tg being the Difference of Two Concords of which the Ear is perfectly Judge, we very easily learn to raise it; and in Fact we know it is the Degree which a natural Voice can with most Ease and

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and Certainty raise from a Fundamental or given Sound. Again, we found that the fame Law of an harmonical and arithmetical Mean resolved the 5th into 3d l. and 3d g. By the harmonical the 3d g. being next the greater Number, as here 10:12:15, and by the arithmetical the 3d l. lowest, as here 4:5:6; and applying this to the upper and lower 5th proreeding from the immediate Division of the 8ve, we have 4 more middle Terms within the 8ve. whereof the lower Two are 3ds to the Fundamental and 6ths to the other Extreme, and the upper Two are 6ths to the Fundamental, and 3ds to the other Extreme, as you fee in the preceeding Series: And this produces Two new Degrees, viz. 24: 25. the Difference of 3d l. and 3d g. or of 6th l. and 6th g. and 15: 16, the Difference of 3d g. and 4th, or of 5th and 6th l. but this Degree 24:25 is too small, and upon that Account rejected, as I have already faid. Now we are to find why this Degree 24: 25 is meoncinnous, and 15:16 concinnous, from fome fettled Constitution and Rule in Nature, which we shall have from this Observation, viz. That if we apply the same Law which resolved the 8ve and 5th into their harmonical Parts, to the 3d g. we have it divided into a tg. and a tl. as in this arithmetical Series 8:9:10; or this harmonical, 36: 40: 45; and if we consider this Analogy, it feems to determine these Two Degrees of tg. 8: 9 and th. 9: 10, to be the true concinnous Parts of 3d g. and thereby excludes \$4: 25; and confequently the Two 3ds and Two

two 6ths from standing both together in one Scale. And now, fince the 5th does not admit of both these middle Terms together which proceed from its harmonical and arithmetical Division, it feems to be but the following of Nature, if we apply the same Kind of Division to the upper and lower 5th of the 8ve; the Effect of which is, that as by the harmonical Division of the lower 5th we have a 3d g. next the Fundamental; fo by the harmonical Division of the upper 5th we have a 6th g. to the Fundamental; and by the arithmetical Divisions we have contrarily the ad 1. and 6th 1. next the Fundamental, as you fee in the preceeding Series: And this is a Kind of natural Proof that the 3d l. and 6th l. also the 3d g. and 6th g. belong to one Series; and here we have the Discovery of the tl. which lies narally betwixt the 3d l. and 4th, or betwixt the 5th and 6th g. But tho' the Two 3ds and Two 6ths cannot stand together, yet there must none of them be loft, and therefore they constitute Two different Scales. But the Division of the 8ve is not finished, for the 3ds that ly next the Extremes are undivided; as to the 3d g. we fee how naturally 'tis refolved into a tg. and tl. which is another Way of discovering these Degrees; and 'tis worth remarking, that the same general Rule which by a gradual Application refolved the 8ve immediately into a 5th and 4th. and then the 5th immediately into 3d g. and 3d l. (by which Divisions the Two 6ths were also found indirectly) being applied to the 3d g. produces immediately the Two principal

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cipal concinnous Intervals; and for the Original of the f. 15: 16. we fee 'tis the Difference of 3d g. and 4th, and rifes not from the immediate Division of any other Interval, but falls here by Accident, upon the Application of the preceeding general Rule to the 8ve and 5th. But we have yet the 3d l. which is next the Extremes to consider; of what concinnous Parts it consists was eafy to fee betwixt the 3d g. and 5th. viz. a f. and tg; but next the Extremes of the 8ve they must be in this Order ascending, viz. tg. and f. Of the Reason of this I have said enough already: And now the Division of the Octave being completed, we have the whole original Concords concinnously divided, and these Intervals added to the System, viz. 8:9, 9: 10, and 15: 16. which have all this in common, that they are the Differences of the 5th and fome other Concords.

Of the particular Names of Intervals, as 8ve, 5th, &c.

We have considered the concinnous Division of every harmonical Interval, and we find the 8ve contains 7 Degrees; the 6th, whether leffer or greater, has 5; the 5th has 4; the 4th has 3; the 3d, lesser or greater, has 2: And if we number the Terms or Sounds contained within the Extremes (including both) of each harmonical Interval, there will be one more than there are of Degrees, viz. in the 8ve there are Q 3

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8. in the 6th 6. in the 5th 5. in the 4th 4. and in the 3d 3. And now at last we understand from whence the Names of 8ve, 6th, 5th, &c. come; the Relations to which these Names are annexed are so called, because in the natural Scale of Musick the Terms that are in these Relations to the Fundamental are the Third, Fourth, &c. in order from that Fundamental inclusively. Or thus, because these harmonical Intervals being concinnously divided, contain betwixt their Extremes (including both) fo many Terms or Notes as the Names 8ve, 6th, frc. bear. For the same Reason also, the Tone or f. (whichever of them stands next the Fundamental) is called a 2d, particularly the Tone (whose Difference of greater and lesser is not strictly regarded in common Practice) is called the 2d g. and f. the 2d l. Also that Term which is betwixt the 6th and 8ve, is called the 7th, which is also the greater 8: 15, or the leffer 5:9. Concerning this Interval we must here remark, that as it stands in primary Relation to the Fundamental in the Division of the 8ve, it does in this respect belong to the System of Musick: But it is also used as a Degree without Division, that is, in Practice we move sometimes the Distance of a 7th at once; but it is in fuch Circumstances as removes the Offence that so great a Discord would of it self create; of which we shall hear more in the next Chapter; and here observe, that it is the Difference of 8ve and the Degrees of Tone and Semitone.

As to the Order in which the Degrees of this Scale follow, we have this to remark, that if either Series, (viz. that with the 3d 1. or with the 3d g.) be continued in infinitum, the Two Semitones that fall naturally in the Division of the 8ve, are always afunder 2 Tones and 3 Tones alternately, i. e. after a Semitone come 2 Tones, then a Semitone, and then 3 Tones; and of the Two Tones one is a greater and the other a lesser; of the Three, one is lesser in the middle betwixt Two greater. If you continue either Series to a double Octave, and mark the Degrees, all this will be evident, Observe also. that this is the Scale which the Ancients called the DIATONICK Scale, because it proceeds by these Degrees called Tones (whereof there are Five in an 8ve) and Semitones (whereof there are Two in an Octave) But we call it also the NATURAL Scale, because its Degrees and their Order are the most agreeable and concinnous, and preferable, by the Approbation both of Sense and Reason, to all other Divisions that have ever been instituted. What these other are, you shall know when I explain the ancient Theory of Musick; but I shall always call this, The Scale of Musick, without Distinction, as 'tis the only true natural System.

We have already observed, that if the Scale of Musick is to be carried beyond an Octave, it must be by the same Degrees, and in the same Order thro' every successive Octave as thro' the first. How to continue the Series of Numbers by a continual Addition, is sufficiently explain'd

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already; and for the Names there are Two Ways, either to compound the Names of the simple Interval with the Octave thus, viz. tg. or f. or 3d, &c. above an Octave, or above Two Octaves, &c. or name them by the Number of Degrees from the Fundamental, as 9th, 10th, &c. but the first Way is more intelligible, as it gives a more distinct and simple Idea of the Distance, just as we conceive a certain Quantity of Time more easily, by calling it, for Example, 9 Weeks, than 63 Days. But that you may readily know how far any Note is removed from the Fundamental, if you know how far it is above any Number of Octaves. See the following Table, wherein the first Line contains the Names of the Notes within one O-Etave; the second Line the Names (with respect to the first Fundamental) of these Terms that are as far above one Octave, as these standing over them in the first are above the Fundamental; and the Third Line the Names of these above Two Octaves.

Fund. 1 | 2d | 3d | 4th | 5th | 6th | 7th | 8th | 9th | 10th | 11th | 12th | 13th | 14th | 15th > 16th | 17th | 18th | 19th | 20th | 21st | 22d.

And this Table may be continued as far as you please; or if you take the Columns of Figures downward, then each Column gives the Names of the Notes or Terms that are equally removed from the Fundamental, from the first Octave,

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Etave, the fecond Octave, &c. Thus the first Column on the left shews the Names of fuch as are a 2d above the Fundamental, above the first Octave, &c. if we consider what is practical then the Scale is limited to Three or Four Octaves, otherwife 'tis infinite. Again observe, that let the Scale be continued to any Extent, every Octave is but a Repetition of the first: and therefore an Octave is said to be a perfect Scale or System, which comprehends Eight Notes with the Extremes; but the Eighth being so like the first, that in Practice it has the same Name, and is the same Way fundamental to the Degrees of a second Octave, and fo on from one Octave to another, gave Occasion to fay there are but seven different Notes in the Scale of Musick; or that all Musick is comprehended in feven Notes; because if we take other seven Notes higher, they are but Repetitions of the first seven in Octave, and have the same Names.

Of the Office of the SCALE.

The Constitution of the Scale being already explained, the Office and Use of it shall be next treated of, which you have exprest in general in the preceeding Definition of it; but that you may have a distinct and clear Notion, I shall be a little more particular. The Defign then of the Scale of Musick is to show how a Voice may rife or fall, less than any harmonical Interval, and thereby move from the one Extreme of any of these to the other, in the most agreeable Succession of Sounds: It is a System which ought to exhibite tousthe whole Principles of Musick, which are either Concords or concinnous Intervals: The Concords or harmonical Intervals are the effential Principles, the other are subservient to them, for making their Application more various. Accordingly we have in this Scale the whole Concords, with all their concinnous Degrees, placed in fuch Order as makes the most perfect Succession of Sounds from any given Fundamental, which I suppose represented in the preceeding Series by 1; fo that the true Order of Degrees thro' any barmonical Interval is, that in which they ly from n upwards, to the acute Term of the given Concord, as to ! for the Octave, ; for the 5th, &c. or downwards from these Terms to the Fundamental 1. The Divisions of the Octave, 5th and 4th are different, according to the Difference of the 3ds, and these Intervals are to be found in primary Relation to the Fundamental, both the preceeding Scales; but the 3dl. and 6th l. belong to the one, and 3dg, and 9th g. to the other Scale.

This Scale not only shews us, by what Degrees a Voice can move agreeably, but gives us also this general Rule, that Two Degrees of one Kind ought never to follow other immediately in a progressive Motion upwards or downwards; and that no more than Three Tones (whereof the middle is a lesser Tone, and the other Two greater Tones) can follow other, but

but a f. or some harmonical Interval must come next; and every Song or Composition within this Rule is particularly called diatonick Musick, from the Scale whence this Rule arises; and from the Effect we may also call it the only natural Musick: If in some Instances there are Exceptions from this Rule, as I shall hereafter have more particular Occasion to observe, 'tis but for Variety, and very feldom practis'd: But this general Rule may be observed, and yet no good Melody follow; and therefore fome more particular Rules must be sought from the Art of Composition. While we are only upon the Theory, you can expect but Theory and general Notions, yet I shall have Occasion afterwards to be more particular on the Limitations, which are necessary for the Conduct of the true musical Intervals in making good Melody, as these Limitations are contained in the Nature of the Scale of Musick. But don't mistake the Design of this Scale of Degrees, as if a Voice ought never to move up or down by any other immediate Distances, but by Degrees; for tho' that is the most frequent Movement, yet to move by harmonical Distances at once is not excluded, and 'tis absolutely necessary: For the' Agreeableness of it, you may consider the Degrees were invented only for Variety, that we might not always move up and down by harmonical Intervals, which of themselves are the most perfect, the others deriving their Agreeableness from their Subserviency to them. Observe, these Tones and Semitones are the Diastems

or simple Intervals of the natural or diatonick Scale. In Ch. 2. § 1. I have defined a Diafem. such an Interval as in Practice is never divided, tho' there may be of these some greater fome leffer. To understand the Definition perfectly, take now an Example in the diatonick Scale: A Semitone is less than a Tone, and both are Diastems; we may raise a Tone by Degrees, first raising a Semitone, and then such a Distance as a Tone exceeds a Semitone, which we may call another Semitone, i. e. from a to b a Semitone, and then from b to c the Remainder of a Tone which is supposed betwixt a c. But this is never done if we would preserve the Character of diatonick Musick, because in that Scale Two Semitones are not to be found together; and if we rife to the Distance of a Tone, it must be done at once; all greater Intervals are divisible in Practice of this Kind of Melody; but in other Kinds practis'd by the Ancients, we find that the Tone was a System, and some greater Intervals were practis'd as Diastems, which shall be explain'd in another Place.

We shall still want something toward a complete and sinished Notion of the Use and Office of the Scale of Musick, till we understand distinctly what a Song truly and naturally concinnous is, and particularly what that is which we call the Key of a Song; and the true Notion of these we shall easily deduce from the Things already explain'd concerning the Principles of Musick; but I find it convenient first to dispatch some remaining Considerations of the Intervals of

§ 4. Of the accidental Discords in the System of Musick.

E have confidered these Intervals and Relations of Tune that are the immediate Principles of Musick, and which are directly applied in the Practice; I mean these Intervals or Relations of Tune, which, to make true Melody, ought to be betwixt every Note or Sound and the immediately next; thele we have confidered under the Distinction of Concords and concinnous Intervals. But there are other discord Relations that happen unavoidably in Musick, in a kind of accidental and indirect Manner; thus, in the Succession of feveral Notes there are to be considered not only the Relations of these that succeed other immediately, but also of these betwixt which other Notes intervene. Now the immediate Succesfion may be conducted fo as to produce good Melody, yet among the distant Notes there may be very gross Discords, that would not be tolerated in immediate Succession, and far less in Consonance. But particularly let us consider how fuch Discords are actually contained in the Scale of Musick: Let us take any one Species, fuppose 254 A TREATISE CHAP. VIII. fuppose that with the 3d g. as here, in which I mark the Degrees betwixt each Term, and the next.

| Names | Fund | 20 | g. | 30 | g. | 4th | 5ti | 6,6 | th | g. 7 | th | g. | Bve |
|---------|------|----|----|----|----|-----|-----|-----|----|------|----|----|-----|
| Ratios. | | | | | | | | | | | | | 1 |
| Degr. | tg | | - | | | | | | | | | | • |

Now the Progression is melodious, as the Terms refer to one common Fundamental, yet there are feveral Discords among the mutual Relations of the Terms, for Example, from 4th to 7th g. is 32:45, also from 2d g. to 6th g. is 27: 40, and from 2d g. to 4th is 27: 32, all Discords. And if we' continue the Series to another Octave, then 'tis plain we shall find all the Discords, less than Octave, that can possibly be in such a Scale, by comparing every Term, from 1 in order upwards, to every other, that's distant from it within an Octave; and tho' there be Difference of the Two Scales of Ascent, the one using the 3d l. and 6th l. and the other the 3d g. and 6th g. yet all the Relations that can possibly happen in the one, will alfo happen in the other, as I shall immediately show you.

Let us therefore take any one of these Series, as that with the 3d g. and 6th g. and continue it to a double Octave, and then examine the Relations of each Term to each. In order to this, I shall anticipate a little upon that

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Part where I am to explain the Art of writing Musick; and here suppose several Sounds in the Order of the preceeding Scale to be represented by fo many Letters; and because every Octave is but the Repetition of the 1st, so that from every Term to the 8th inclusive, is always a just Octave in the Relation of 1:2; therefore to represent such a Scale by Letters, we need but 7 different ones, A, B, C, D, F, F, G, which will answer the first 7 Terms of the Octave, and the 8th will be represented by the first Letter; and so in order again to another Octave. And that all Things may be as distinct as poffible, we shall make every 7 Letters in order from the Beginning of a different Character; but for a Reason that will appear afterwards, instead of beginning with A, I shall begin with C, and proceed in this Order,

C:D:E:F:G:A:B:c:d:e:f:g:a:b::cc.

where Crepresents the Fundamental and lowest Note of the Scale; and the rest are in order acuter. And now when any Interval is expressed by Two Letters, it will be easy to know in which Octave (i.e., whether in the first or second in order from the Fundamental) each Extreme is; for if they be both one Kind of Character, then they are both in one Octave, as C-F; otherwise they are in different Octaves, as A-f. And it will be easily known whether the Interval be equal to, or greater or less than an Octave; for from any Letter to the like Letter

is an Octave, or Two Octaves, as c-c is an Octave, or C-cc Two Octaves, consequently A-b is known at Sight to be greater than an Octave, even as far as b is above a; and B-D to be less. Again, by this Means we easily know whether the Example is taken ascending or descending, so 'tis plain, that from D to a is ascending, or from d to g; but from f to d is descending, or from d to E: The Order of the several Letters, and their different Characters determine all these Things with great Ease.

ACCORDING to this Supposition, then, I have express'd the Scale by these Letters, in a Table calculated for the Purpose of this Section, (See Plate 1. Fig. 5.) In the first Column on the left you have the Names of the Intervals, as they proceed in Order from a common Fundamental; in the 2d you have the Progression of Degrees from every Term to the next; in the ad you have the feveral Terms expressed by Letters; in the 4th Column you have the Numbers that express the Relations of every Term to the Fundamental C (which is 1) as far as Two Octaves, taken in the natural Order of the concinnous Parts of the Octave, as above divided and explained, these being supposed to be fixed Relations; then in the other Columns you have expressed the Relations of every Term, in order upwards from C, to all these above them, as far as an Octave; reduced to a com-mon Fundamental 1, which is the first Number in every Column, and fignifies that the Letter

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or Note against which it stands, is supposed to be a common Relative to the 7 Terms that stand next above it, i.e. That the other Numbers of that Column compared to 1, express the Relations which the Notes, or Letters against which they stand, bear to that against which the 1 of that Column stands, according to the fixt Relations supposed in the Fourth Column of Numbers. The 11th Column is the fame with the if; and if we would carry on that Table in infinitum, it would be but a Repetition of the preceeding 7 Columns of Numbers; which shews us that Two Octaves was sufficient to discover all the simple Discords that could possibly be in the Scale. I have carried these Columns no further than one Octave, except the first, because all above are but an 8ve, and fome leffer compounded; and therefore we needed only to find all the simple Discords less than an 8ve: But the 1st Column is carried to Two 8ves, because the rest are made out of it; for these other express the mutual Relations of each Term of the 1st Column to all above it within an Octave, reduced to a common Fundamental 1.

I'll next show you that there are no other Relations in the other Series, which ascends by a 3d l. and 6th l. than what are here. The two Species differ only in the 7ths, 6ths and 3ds, and if you'll look but a little back, you'll see the true Relation of the Terms of that other Series to the Fundamental, which if you compare with that Column in this Table, which begins against E, you'll find them the same in every

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Term but one; for here the 2d Term is 15: 16 which there is 8:9; but if you compare the Column which begins against A, you'll find that agree with the Scale we are speaking of in every Term but the 4th, which is here 20:27, and there 3:4, the one wants the true 2d, and the other the true 4th; but both these are in the first Column which begins at C; therefore 'tis plain that if these Columns are continued, we must find in them all the Relations that can possibly be in that Scale; which a little Examination will soon discover.

Now besides the harmonical Intervals and Degrees already explained, we have in this Table the following discord Relations, which proceed from the Differences of the Degrees, and the particular Order in which they follow other

| Exa. | Ratios |
|-------------|--|
| DF | = 27:32 |
| F B | |
| III A D | = 20:27 |
| DHA | = 27:40 |
| BBOF | = 45:64 |
| FD | = 16:27 |
| $\cdot D C$ | = 9:16 |
| | THE RESERVE OF THE PARTY OF THE |

in the Scale; for we may conceive a great Variety of other Discords from different Combinations of these Degrees, but the Speculation would be of no Use; 'tis enough to consider what are inavoidable in the Order of the Scale of

Musick, which are these mentioned. Again, from the Table we find plainly that from any Note or Letter of the Scale, to the 2d, 3d, 4th, 5th, &c. inclusive, either above or below, is not always the same Interval; because the there is

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an equal Number of Degrees in every such Case, yet there is not always an equal Number of the same Degrees; so, from C to F, there are three Degrees, whereof I is a tg. I is t l. and I a s. but from F to B there are Three Degrees,

whereof 2 are tg. and 1 is a tl.

W E have already fettled the Definitions of a 3d, 4th, &c. as they are harmonical Intervals, they are either to be taken from the true Ratios of their Extremes; or, respecting the Scale of Musick, from the Number and particular Kinds of Degrees; yet we may make a general Definition that will ferve any Part of the Scale, and call that Interval, which is from any Letter of the Scale to the 2d, 3d, 4th, &c. inclusive; a 2d, a 3d, a 4th, &c. But then we must make a Distinction, according as they are harmonical or not; under which Distinction the Octaves will not come, because every Eight Letter inclusive is not only the same, but is a true Octave in the Ratio of 1:2; which is plain from this, That every Octave in order from the Fundamental or lowest Note of the Scale, is divided the fame Way, into the fame Number of the same Kind of Degrees, and in the same Order: And for other Intervals less than an Octave, we have Three of each Kind, differing in Quantity; which Differences arise from the Three different Degrees, as I have expressed them in the following Tables wherein the greatest stands uppermost, and so in Order

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| 2ds. | 1 3ds. | I 4ths. | I 5ths. | I 6ths. | [7ths.] |
|-------|--------|---------|-----------------------|---------|---------|
| 8:9 | 4:5 | 32:45 | 2:3 | 16:27 | 8:15 |
| 9:10 | 5:6 | 20:27 | 2:3 27:40 45:64 | 3:5 | 5:9 |
| 15:16 | 27: 32 | 3:4 | 45:64 | 5:8 | 9:16 |

THE Three 2ds or Degrees are all concinnous Intervals; of the 3ds one is Discord, viz. 27: 32, and therefore called a false 3d; the other Two are particularly known by the Names of 3dg. and 3dl. of the 4ths and 5ths Two are Discords, and called false 4ths and 5ths; and therefore when we fpeak of a 4th or 5th, without calling it false, 'tis understood to be of the true harmonical Kind; of the 6ths one is falle, and the other Two which are harmonical, are called 6th g. and 6th l. the 7ths are neither harmonical nor concinnous Intervals, yet of Use in Musick, as I have already mentioned; the Two greater are particularly known by the Name of greater or leffer 7th, tho' fome I know make the least 9: 16 the 7th lesser; I mean they make that Ratio a Term in the Division of the Octave by 3d l. and 6th l. but I shall have Occasion to consider this more particularly in another Place. Now, as to the Composition of the Octave out of the Intervals of this last Table, we have this to remark, that if we compare the 2ds with the 7ths, or the 3ds with the 6ths, or 4ths with 5ths, the greater of the one added to the lesser of the other, or the Middle of the one added to the Middle of the

the other, is exactly equal to Octave; and generally add the greatest of any Species of Intervals (for Example 5ths) to the lesser of any other (as 3ds) and the least of that to the greater of this; also the Middle of the one to the Middle of the other, the Three Sums or Intervals proceeding from that Addition are e-

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We shall next consider what the Errors of these false Intervals are. The Variety, as to the Quantity, of Intervals that have the same Number of Degrees in the Scale, arises, as I have already faid, from the Differences of the Three Degrees; and therefore the Differences among Intervals of the same Species and Denomination, i. e. the Excesses or Defects of the false from the true, are no other than the Differences of these Degrees, viz. 80: 81, the Difference of a tg. and tl. which is particularly called a Comma among Musicians; 24: 25, the Difference of a tl. and f. which is sometimes called a lesser Semitone, because it is less than 15:16; then 128:135, the Difference of a tg. and f. which is a greater Difference than the last, and is also called a lesser Semitone, and is a Middle betwixt 15: 16, and 24: 25. Betwixt which of the greater Intervals these Differences do particularly exist, will be easily found, by looking into the former Table, and applying Problem 10. of Chap. 4. that is, multiplying the Two Ratios compared cross-ways, the greater Number of the one by the lesser of the other, the Products contain the Ratio or R 3 Dif-

Difference fought. Observe also, that the greatest of the 4ths, viz. 32: 45 is particularly called a Tritone, for 'tis equal to 2 tg. and 1 tl. and its Complement to an Octave, viz. 45: 64, which is the least of the 5ths, is particularly called a leffer 5th or Semidiapente (the Original of the last Name you'll hear afterwards.) These Two are the falle 4th and 5th, which are used as Discords in the Business of Harmony, and they are the Two Intervals which divide the Octave into Two Parts nearest to Equality, for their Difference is only this very finall Interval 2025: 2048. And because in common Practice the Difference of tg. and tl. is neglected, tho' it has its Influence, as we shall hear of, therefore these Intervals are only called falle, which exceed or come short by a Semitone; and upon this Supposition therefore there is no false 3d or 6th, nor any false 4th or 5th, except the Tritone and Semidiapente mentioned, which with the 7ths and 2ds are all the Discords reckoned in the System; however when we would know the Nature of Things accurately, we must neglect no Differences.

THE Distinctions already made of the Intervals of the Scale of Musick, regard their Contents as to the Number and Kind of Degrees; but in the Scale we find Intervals of the fame Extent, differing in the Order of their Degrees. We shall easily find the whole Variety, by examining the Scales of Musick; for the Variety is increased by the Two different Series or Scales above explained, there being fome in the one

that

that are not to be found in the other. I shall leave it to your felves to examine and find out the Examples, and only mention here the O-Haves, whereof there are in this respect seven different Species in each Scale, proceeding from the feven different Letters; for it is plain at fight, that the Order of Degrees from each of these Letters upward to an Octave is different; and that there can be no more Variety if the Scale were continued in infinitum, because from the same Letter taken in any Part of the Scale, there is always the same Order. What Use has been made of this Distinction of Intervals. and particularly Octaves, falls to be confidered in another Place; I shall only observe here, that tho' all this Variety happens actually within the Compass of Two Octaves, yet if you ask, what is the most natural and agreeable Order in the Division of the Octave, it is that which belongs to the Octave from C in the preceeding Scale; or change the 3d, 6th and 7th from greater to lesfer, and that makes another concinnous Order; the Degrees of each as they follow other, you have already fet down. Now if you begin and carry on the Series in any of these Two Orders to a double Octave, none of the accidental Discords will give any Offence to the Ear, because their Extremes are not heard in immediate Succession; and the Discord is rendred altogether infensible by the immediate Notes; especially by the harmonious Relation of each Term to the common Fundamental, and the manifold Concords that are to be found among

among the feveral middle Terms. For the Pofitions of the Degrees, which occasion these Discords, it we consider them with respect to the Fundamental C, they are truly concinnous, but with respect to the lowest of Two Notes, betwixt which they make the Discord, they follow inconcinnously from it, because they were not defigned to follow it as a Fundamental, and fo are not to be referred to it: Therefore in all the Scale, only C can be made fundamental, because from none of the other Six Letters do the Degrees follow in a right concinnous Order, unless, as I said before, we neglect the Difference of tg. and tl. and then the Octave from A will be a right concinnous Series, proceeding by a 3d l. when it proceeds by a 3dg. from C, and contrarily; and hereby we shall have both the Species in one Series; otherwise there are Three Terms that are variable, which are the 3d, 6th and 7th from the Fundamental, i. e. E, A, B, when the Fundamental is called C; and this must be carefully minded when we speak of the Scale of Musick. How unavoidable these Kinds of Discords are among the Notes of the Scale, we have feen; but, as I have already observed, there are other Successions that are melodious, besides a constant Succession of Degrees; these are mixt in Practice with harmonical Intervals: And here also the immediate Succesfion many be melodious, tho' there be many Difcords among the distant Notes, whose Harshness is rendred altogether infensible from their Situation, especially because of the harmonical Relation Relation of the feveral Notes to some fundamental or principal Note, which is called the Key, with a particular Respect to which the rest of the Notes are chosen.

CHAP. IX.

Of the Mode or Key in Musick; and a further Account of the true End and Office of the Scale of Musick.

6 1. Of the Mode or Key.

E have already divided the Application of the Tune of Sounds into these Two, Melody and Harmony. feveral fimple Sounds fucceed other agreeably in the Ear, that Effect is called Melody; the proper Materials of which are the Degrees and harmonious Intervals above explained. But 'tis not every Succession of these that can produce this Pleafure; Nature has marked out certain Limits for a general Rule, and left the Application to the Fancy and Imagination; but always under the Direction of the Ear. The other chief Ingredient in Musick is the Duration, or Difference of Notes with respect to their uninterrupduckness or Slowness of their Succession; taking in both these, a melodious Song may be brought under this general Definition, viz. A Collection of Sounds or Notes (however produced) differing in Tune by the Degrees or harmonious Intervals of the Scale of Munck, which succeeding other in the Ear, after equal or unequal Duration in their respective Tunes, affect the Mind with Pleasure. But the Design of this Chapter is only to consider the Nature and general Limits of a Song, with respect to Tune, which is properly the Melody of it; and observe, That by a Song I mean every single Piece of Musick, whether contrived for a Voice or Instrument.

A Song may be compared not abfurdly to an Oration; for as in this there is a Subject, viz. fome Person or Thing the Discourse is referred to, that ought always to be kept in View, thro' the Whole, fo that nothing unnatural or foreign to the Subject may be brought in; in like Manner, in every regular and truly melodious Song, there is one Note which regulates all the rest; the Song begins, and at least ends in this, which is as it were the principal Matter, or musical Subject that demands a special Regard to it in all the other Notes of the Song. And as in an Oration, there may be feveral distinct Parts, which refer to different Subjects, yet fo as they must all have an evident Connection with the principal Subject which regulates and influences the Whole; fo in Melody, there may

be feveral subprincipal Subjects, to which the different Parts of that Song may belong, but these are themselves under the Influence of the principal Subject, and must have a fensible Connection with it. This principal Note is called the Key of the Song, or the principal Key with respect to these others which are the Subprincipal Keys. But a Song may be fo short, and fimply contrived, that all its Notes refer only to

one Key.

THAT we may understand this Matter diftinctly, let us reflect on some Things already explained: We have feen how the Octave contains in it the whole Principles of Musick, both with respect to Consonance (or Harmony) as it contains all the original Concords, and the harmonical Division of such greater, as are equal to the Sum of lesser Concords; and with respect to Succession (or Melody) as in the concinnous Division of the Octave, we have all the Degrees subservient to the harmonical Intervals, and the Order in which they ought to be taken to make the most agreeable Succession of Sounds, rising or falling gradually from any given Sound, i. c. any Note of a given and determined Pitch of Tune; for the Scale supposes no Pitch, and only assigns the just Relations of Sound which make true musical Intervals: But as the 3ds and 6ths are each distinguished into greater and lesser, from this arise Two different Species. in the Division of the Octave. We have also observed, That if either Scale (viz. That which proceeds by the 3d l. or by the 3d g.)

is continued to a double Offave, there shall be in that Case 7 different Orders of the Degrees of an 8ve, proceeding from the 7 different Letters with which the Terms of the Scale are marked: none of which Orders but the first, viz. from C is the natural Order; and tho' in raising the Series from C to the double Octave, we actually go through the Degrees in each of these Orders, yet C only being the Fundamental, to which all the Notes of the Series are referred, there is nothing offensive in these different Orders, which are but accidental; fo that in every Octave concinnoully divided, there are 7 different Intervals relative to the Fundamental, whose acute Terms are the effential Notes of the Octave, and they are these, viz. the 2dg. 3dg. 4th, 5th, 6thg. 7th g. 8ve, or 2d g. 3d l. 4th, 5th, 6th l. 7th 1. 8ve.

Now, let us suppose any given Sound, i.e. a Sound of any determinate Pitch of Tune, it may be made the Key of a Song, by applying to it the Seven essential or natural Notes that arife from the concinnous Division of the 8ve, as I have just now set them down, and repeating the 8ve above or below as oft as you pleafe. The given Sound is applied as the principal Note or Key of the Song, by making frequent Closes or Cadences upon it; and in the Course or Progress of the Melody, none other than these Seven natural Notes can be brought in, while the Song continues in that Key, because every other Note is foreign to that Fundamental or Key. To

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To understand all this more distinctly, let us consider, That by a Close or Cadence is meant a terminating or bringing the Melody to a Period or Rest, after which it begins and sets out anew, which is like the finishing of some distinct Purpose in an Oration; but you must get a perfect Notion of this from Experience. Let us fuppose a Song begun in any Note, and carried on upwards or downwards by Degrees and harmonical Distances, so as never to touch any Notes but what are referable to that first Note as a Fundamental, i. e. are the true Notes of the natural Scale proceeding from that Fundamental; and let the Melody be conducted for through these natural Notes, as to close and terminate in that Fundamental, or any of its 8ves above or below; that Note is called the Key of the Melody, because it governs and regulates all the rest, putting this general Limitation upon them, that they must be to it in the Relation of the Seven effential and natural Notes of an 8ve, as abovementioned; and when any other Note is brought in, then 'tis faid to go out of that Key: And by this Way of speaking of a Song's continuing in or going out of a Key, we may observe, that the whole 8ve, with all its natural and concinnous Notes, belong to the Idea of a Key, tho' the Fundamental, being the principal Note which regulates the rest, is in a peculiar Sense called the Key, and gives Denomination to it in a System of fixt Sounds, and in the Method of marking Sounds by Letters, as we shall hear of more particularly afterwards. And And in this Application of the Word Key to one fundamental Note, another Note is said to be out of the Key, when it has not the Relation to that Fundamental of any of the natural Notes that belong to the concinnous Division of the 8ve. And here too we must add a necessary Caution with respect to the Two different Divisions of the 8ve, viz. That a Note may belong to the same Key, i. e. have a just musical Relation to the same Fundamental in one Kind of Division, and be out of the Key with respect to the other: For Example, If the Melody has used the 3d g. to any Fundamental, it requires also the 6th g. and therefore if the 6th l. is brought in, the Melody is out of the first Key.

Now a Song may be carried thro' several Keys, i. e. it may begin in one Key, and be led out of that to another, by introducing some Note that is foreign to the first, and so on to another: But a regular Piece must not only return to the first Key, these other Keys must also have a particular Connection and Relation with the first, which is the principal Key. The Rule which determines the Connection of Keys, you'll find distinctly explained in Chap. 13. for we may not change at random from one Key to another; I shall only observe here, that these other Keys must be some of the Seven natural Notes of the principal Key, yet not any of them; for which

fee the Chapter referred to.

But that you may conceive all this yet more clearly, we shall make Examples. Suppose the following Scale of Notes exprest by Letters, where-

wherein I mark the Degrees thus, viz. a t g. with a Colon (:) a tl. with a Semicolon (;) Semitone with a Point (.) And here I mark the Series that proceeds with the 3d g, &c.

C: D; E. F: G; A: B. c: d; e.f:g; a:b.c

The first Note represents any given Sound, and the rest are fixt according to their Relations to it, exprest by the Degrees: Let the first Note of the Song, which is also the designed Key, be taken Unison to C. (which represents any given Sound) all the rest of the Notes, while it keeps within one Key, must be in such Relation to the first, as if placed according to their Distances from it in a direct Series, they shall be unifon each with fome Note of the preceeding Scale: The Example is of a Key with the 3d g, &c. which is eafily applied to the other Species. Let us now suppose the Conduct of the Melody such. that after a Cadence in C the Song shall make the next Cadence in a 3d g. above, viz. in E, and this is a new Key into which the Melody goes.

We have observed in the preceeding Chap. that the Order of Degrees from each of the Letters of the diatonick Scale, is different; and therefore while the Relation of these Notes are supposed fixt, 'tis plain none of the Notes of that Scale except C can be made a Key, because the Seven Notes within the 8ve are not in the true Relation of the essential and natural Notes of an 8ve concinnously divided;

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and therefore the natural Scale (i.e. the Order from () must be applied anew from every new Key; as in the preceeding Example, the 2d Key is E. which in that Scale has a 3d l. at G, but it has not all its Seven Notes in just Relation to the Fundamental, the first Degree being a f. which ought to be tg; and therefore if the Melody in that Key be so managed as to have Use for all the Seven natural Notes, they cannot be all found in the Series that proceeds concinnously from C, but requires the Application of the natural Scale to that new Pitch, i. e. requires that we make a Series of concinnous Degrees from that new Fundamental; which we may express either by calling it C, and applying the fame Names to the whole 8ve, above or below it, as to the former Key, or retaining still the Names E F, &c. to an 8ve, but supposing their Relations changed.

A Song may be so ordered, that it shall not require all the Seven natural Notes of the Key; and if the Melody be so contrived in the subprincipal Keys of the Song, that it shall use none of the essential Notes of these Keys, but such as coincide with these of the principal Key, then is the whole of that Song more strictly limited to the principal Key: So that in a good Sense it may be said never to go out of it; but then there will be less Variety under such Limitations: And if a Song may be supposed to go through several Keys, the principal being always persect as from C, and the Subprincipals taken with such Impersections as they unavoidably have, when

we are confined to one individual Series of determinate Sounds, the Musick may be faid also in this Case never to depart from the principal Key; but 'tis plain, that the using such Intervals with respect to the subprincipal Keys, will make the Melody imperfect, and also occasion Errors of worse Consequence in the Harmony

of Parts fo conducted.

'Tis Time now to consider the Distinctions of Keys. We have feen that to constitute any Note or given Sound a Key or fundamental Note, it must have these Seven essential or natural Notes added to it, viz. 2d g. 3d g. or 3dl. 4th, 5th, 6th g. or 6th l. 7th g. or 7th l. 8ve out of which, or their 8ves, all the Notes of the Song must be taken while it keeps within that Key, i. e. within the Property of that Fundamental; 'tis plain therefore, that there are but Two different Species of Keys, according as we joyn the greater or lesser 3d, which are always accompanied with the 6th and 7th of the same Species, viz. the 3d g. with the 6th g. and 7th g; and the 3dl. with the 6th.l. and 7th 1; and this Distinction is marked with the Names of A SHARP KEY, which is that with the 3dg, &c. and A FLAT KEY with the 3dl, &c. Now from this it is plain, that however many different Closes may be in any Song, there can be but Two Keys, if we consider the essential Difference of Keys; for every Key is either Sharp or flat, and all sharp Keys are of the same Nature, as to the Melody, and so are all fla: Keys; for Example, Let the principal Key o.

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a Song be C (with a 3d g.) in which the final C ofe is made, let other Closes be made in E (the 3d of the principal Key) with a 3d g. and in A (the 6th of the principal Key) with a 3dl. yet in all this there are but Two different Keys, Sharp and flat: But observe, in common Practice the Keys are faid to be different when nothing is considered, but the different Tune or Pitch of the Note in which the different Closes are made; and in this Sense the fame Song is faid to be in different Keys, according as it is begun in different Notes or Degrees of Tune. But that we may speak accurately, and have Names answering to the real Differences of Things, which I think necessary to prevent Confusion, I would propose the Word Mode, to express the melodious Constitution of the Octave, as it consists of Seven essential or natural Notes, besides the Fundamental; and because there are Two Species, let us call that with a 3dg. the greater Mode, and that with a 3dl. the lesser Mode: And the Word Key may be applied to every Note of a Song, in which a Cadence is made; fo that all these (comprehending the whole Octave from each) may be called different Keys, in respect of their different Degrees of Tunes, but with respect to the effential Difference in the Constitution of the Octaves, on which the Melody depends, there are only Two different Modes, the greater and the lesser. Thus the Latin Writers use the Word Modus, to signify the particular Mode or Way of constituting the Octave;

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and hence they also called it Constitutio; but of this in its own Place.

"Tis plain then, that a Mode (or Key in this Sense) is not any single Note or Sound, and cannot be denominated by it, for it fignifies the particular Order or Manner of the concinnous Degrees of an 8ve, the fundamental Note of which may in another Sense be called the Key, as it fignifies that principal Note which regulates the rest, and to which they refer: And even when the Word Key, applied to different Notes; fignifies no more than their different Degrees of Tune, these Notes are always considered as Fundamentals of an 8ve concinnously divided tho' the Mode of the Division is not considered when we call them different Keys; fo that the whole 8ve comes within the Idea of a Key in this Sense also: Therefore to distinguish properly betwixt Mode and Key, and to know the real Difference, take this Definition, viz. an 8ve with all its natural and concinnous Degrees is called a Mode, with respect to the Constitution or the Manner and Way of dividing it; and with respect to the Place of it in the Scale of Musick; i. e. the Degree or Pitch of Tune, it is called a Key, tho' this Name is peculiarly applied to the Fundamental. Hence it is plain, that the fame Mode may be with different Keys, that's to fay, an Octave of Sounds may be raifed in the fame Order and Kind of Degrees, which makes the fame Mode, and yet be begun higher or lower, i. e. taken at different Degrees of Time, with respect to the Whole, which makes different Keys:

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Keys. It follows also from these Definitions, that the same Key may be with different Modes, that is, the Extremes of Two Octaves may be in the same Degree of Tune, and the Division of them different. The Manner of dividing the Octave, and the Degree of Tune at which it is begun, are so distinct, that I think there is Reafon to give them different Names; yet I know, that common Practice applies the Word Key to both; so the same Fundamental constitutes Two different Keys, according to the Division of the Octave; and therefore a Note is faid to be out of the Key, with respect to the same Fundamental in one Division, which is not so in another, as I have explained more particularly a little above; and the fame Song is faid to be in different Keys, when there is no other Difference, but that of being begun at different Notes. Now, if the Word Key must be used both Ways, to keep up a common Practice, we ought at least to prevent the Ambiguity, which may be done by applying the Words sharp and flat. For Example. Let the same Song be taken up at different Notes, which we call C and A, it may in that respect be said to be in different Keys, but the Denomination of the Key is from the Close, and Two Songs clofing in the same Note, as C, may be faid to be in different Keys, according as they have a greater or lesser 3d; and to distinguish them, we say the one is in the sharp Key C, and the other in the flat Key C, and therefore, when sharp or flat is added to the Letter or Name by which any funda-

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fundamental Note is marked, it expresses both the Mode and Key, as I have distinguished them above; but without these Words it expresses nothing but what I have called the Key in Distinction from Mode. But of the Denominations of Keys in the Scale of Musick, we shall hear par-

ticularly in Chap. 11.

Observe next, that of the natural Notes of every Mode or Octave, Three go under the Name of the effential Notes, in a peculiar Manner, viz. the Fundamental, the 3d, and 5th, their Octaves being reckoned the same, and marked with the fame Letters in the Scale; the rest are particularly called Dependents. But again, the Fundamental is also called the final, because the Song commonly begins and always ends there: The 5th is called the Dominante, because it is the next principal Note to the final, and most frequently repeted in the Song; and if 'tis brought in as a new Key, it has the most perfect Connection with the principal Key: The 3d is called the Mediante, because it stands betwixt the Final and Dominante as to its Use. But the 3d and 5th of any Mode or Key deserve the Name of effential Notes, more peculiarly with respect to their Use in Harmony, because the Harmony of a 3d, 5th and 8ve, is the most perfect of all others; fo that a 3d and a 5th, applied in Consonance to any Fundamental, gives it the Denomination of the Key; for chiefly by Means of these the Cadence in the Key is performed. The Bass being the governing Part with respect to the Harmony, ought finally to

close in the Key; and the Relation or Harmony of the Parts at the final Close, ought to be so perfect, that the Mind may find entire Satisfaction in it, and have nothing further to expect. Let us suppose Four Voices, making together the Harmony of these Four Notes G-c-e-g, where G is the Fundamental, c a 4th, e a 6th g. and g an 8ve; fo that c-e is a 3dg. and e-g a 3d l. and c-g a 5th. The Ear would not reft in this Close, because there is a Tendency in it to fomething more perfect; for the true Key in these Four is c, to which the 3d and 5th is applied; the Bass closing in G puts the 5th out of its proper Place, for it ought to stand next the Fundamental; nor can the 3d be separate from the 5th, which can stand with no other. Now the Thing required is, to restore the 5th to its due Place, and this is done, by removing the 4th to the upper Place of the Harmony; fo in the preceeding Example, suppose the Bass moves from G to c, and the rest move accordingly till the Four make these c - e - g - cc, in which c-e is 3dg, c-g a 5th; then we have a perfect Close, and the Musick is got into the true and principal Key, which is c.

WE have one Thing more to observe as to the 7th, which is natural to every Mode; in the greater Modes or Sharp Keys 'tis always the 7th g. but flat Keys use both the 7th g. and 7th 1. in different Circumstances: The 7th 1. most naturally accompanies the 3dl. and 6thl. which constitute a flat Key, and belongs to it necefnecessarily, when we consider the concinnous Division of the Octave, and the most agreeable Succession of Degrees; and it is used in every Place, except it is sometimes toward a Close, especially when we ascend to the Key, for then the 7thg. being within a s. of the Key, makes a smooth and easy Passage into it, and will sometimes also occasion the 6thg. to be brought in. Again, 'tis by Means of this 7thg. that the Transition from one Key to another is chiefly performed; for when the Melody is to be transferred to a new Key, the 7thg. of it (whether 'tis a sharp or flat Key) is commonly introduced: But you shall have more of this in Chap. 13.

I have faid, that the 7th is used in Melody as a single Degree, but in such Circumstances as removes the Harshness of so great a Discord, as particularly in quick Movements; and we may here consider, that a 7th being the Complement of a true Degree to Octave, partakes of the Nature of a Degree so far, that to move upward by a Degree, or downwards by its Correspondent 7th, and contrarily downwards by a Degree, or upwards by a 7th, brings us into the same Note; and from this Connection of it with the true Degrees, 'tis frequently useful.

§ 2. Of the Office of the Scale of Musick.

Now from what has been explained, we very easily fee the true and proper Office of the Scale of Musick, which, strictly speaking, is all comprehended in an Octave, what is above or S 4 below

below being but a Repetition. The Scale supposes no determinate Pitch of Tune, but that being assigned to the Fundamental, it marks out the Tune of the Rest with relation to it. We learn here how to pass by Degrees most melodiously, from any given Note to any har-monical Distance. The Scale shews us, what Notes can be naturally joyned to any Fundamental, and thereby teaches us the just and natural Limitations of Melody. It exhibites to us all the Intervals and Relations that are essential and necessary in Musick, and contains virtually all the Variety of Orders, in which these Relations can be taken fuccessively; if a Song is confined to one Key, the Thing is plain, if 'tis carried thro' feveral Keys, it may feem to require several distinct Series; yet the Musick in every Part being truly diatonick, 'tis but the fame natural Scale (with its Two different Species) applied to different fundamental Notes. And this brings us to confider the Effect of having a Series of Sounds fixt to the Relations of the Scale: If we suppose this, it will easily appear how insufficient such a Scale is for all the agreeable Variety of Melody: But then, this Imperfection is not any Defect in the natural System, but follows accidentally, upon its being confined to this Condition: For this is not the Nature and Office of the Scale of Mufick, that supposing its Relations all expressed in a Series of determinate Sounds, that individual Series should contain all the Variety of Notes, that can melodiously succeed other; unlefs

less you'll suppose every Song ought to be limited to one Key; but otherwise one individual diatonick Series of fixt Sounds is not fufficient. Let us suppose the Scale of Musick thus defin'd, viz. a Series of Sounds, whose Relations to one another are fuch, that in one individual Series, determined in these Relations, all the Notes may be found that can be taken fuccessively to make true Melody; fuch a System would indeed be of great Use, and be justly reckoned a perfeet System; but if the Nature of Things will not admit of fuch a Series, then 'tis but a Chimera; and yet it is true, that the natural Scale is a just and perfect System, when we consider its proper Office as I have exprest it above, and as we shall understand further from the next Chapter, in which I shall consider more particularly the Defect of Instruments having fixt and determinate Sounds, and the Remedy applied to it; and comparing this with the Capacity of the buman Voice, we shall plainly understand, in what different Senses the Scale of Musick explained, ought to be called a perfett or imperfect System.

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CHAP. X.

Concerning the Scale of Musick limited to fixed Sounds, explaining the Defects of Instruments, and the Remedies thereof; wherein is taught the true Use and Original of the Notes we commonly call sharp and flat.

1. Of the Defects of Instruments, and of the Remedy thereof in general, by the Means of what we call Sharps and Flats.

HE Use of the Scale of Musick has been largely explain'd, and the general Limitations of Melody contained in it. Why the Scale exhibited in the preceeding Chapters is called the natural, and the diatonick Scale, has been also said, and how Musick composed under the Limitations of that Scale is called diatonick Musick.

LET us now conceive a Series of Sounds determined and fixt in the Order and Proportions of that Scale, and named by the same Letters. Suppose, for Example, an Organ or Harpsichord, the lowest or gravest Note being taken at any Pitch of Tune; it is plain, 1 mo. That we can proceed from any Note only by one particular Order of Degrees; for we have shewn before, that from every Letter of the Scale to its Octave, is contain'd a different Order of the Tones and Semitones. 2do. We cannot for that Reason find any Interval required from any Note or Letter upward or downward; for the Intervals from every Letter to all the rest are also limited; and therefore, 3tio. A Song (which is truly diatonick) may be fo contrived, that beginning at a particular Letter or Note of the Instrument, all the Intervals of the Song, that is, all the other Notes, according to the just Distances and Relations defigned by the Composer, shall be found exactly upon that Instrument, or in that fixt Series; yet should we begin the Song at any other Note, we could not proceed. This will be plain from Examples, in order to which, view the Scale expressed by Letters, in which I make a Colon (:) betwixt Two Letters, the Sign of a greater Tone 8:9, a Semicolon (3) the Sign of a leffer Tone 9: 10, and a Point (.) the Sign of a Semitone 15: 16. And these Letters I suppose represent the several Notes of an Instrument, tuned according to the Relations marked by these Tones and Semitones-

C:D; E.F:G; A: B.c:d; e.f:g; a:b.cc

Here we have the diatonick Series with the 3d and 6th greater, proceeding from C; and therefore, if only this Series is expressed, some Songs composed with a flat Melody, i. e. whose Key has a lesser 3d, &c. could not be performed

on this Instrument, because none of the Octaves of this Series has all the natural Intervals of the diatonick Series, with a 3d lesser, as they have been shewn in Chap. 8. For Example, the Octave proceeding from E has a 3dl. but instead of a tg. next the Fundamental, it has a Semitone. Again, the Octave A has a 3d l. but it has a false 4th from A to d, being Two greater Tones and a Semitone in the Ratio of 20:27. Let us then suppose, that a Note is put betwixt c and d, making a true 4th with A, to make the Octave A a true diatonick Series. By this Means we can perform upon this Instrument most Songs, that are so simple as to be limited within one Key, I mean that make Closes or Cadences only in one Note; for every Piece of diatonick Melody being regulated by the Intervals of that Scale, and every Key or Mode being either the greater or lesser (i. e. having either a 3d greater or leffer, with the other Intervals that properly accompany them, which have been already shewn) 'tis plain, that beginning at A or E on this Instrument, we can find the true Notes of any fuch simple Song, as was supposed; unless the Melody in the flat Key is so contrived, as to use the 6th and 7th greater, as I have faid it may do in some Circumstances, for then there will be still a Detect, even as to fuch simple Songs.

But there are many other confiderable Reafons why this Instrument is yet very imperfect. And imo. Confider what has been already said concerning the Variety of Keys or Gloses, which may be in one Piece of Melody; and then we shall find that this fixt Series will be very infufficient for a Song contrived with fuch Variety; for Example, a Song whose principal Key is C with its 3d g. may modulate or change into F; but on this Instrument F has a falle 4th at B, and if a true 4th is required in the Song, 'tis not here; or if it modulate into D. then we have a false 3d at F, and a false 5th at A, which are altogether inconfistent with right Melody; 'tis true that the Errors in this last Case are only the Difference of a greater and lester Tone, as you'll find by considering how many, and what Kind of Degrees the true 3d and 5th contains; or by confidering their Proportions in Numbers, in the Tables of Chap. 8. And this Difference is in the common Account neglected, tho' it has an Influence, of which I shall speak afterwards; but where the Error is the Difference of a Tone and Semitone, it is fo gross, that it can in no Case be neglected; as the false 4th betwixt F and B; or when a Semitone occurs where the Melody requires a Tone; for Example, if from the Key C there is a Change into E, to which a tg. is required. we have in the Instrument only a Semitone. And to fay it all in few Words, 1mo. The harmonical and concinnous Intervals of which all true Melody confifts, may be so contrived, or taken in Succession, that there is no Letter or Note of this Instrument at which we can begin, and find all the rest of the Notes in true Proportion, which yet is not the Fault of the Scale, that not chart / being

being the Office of it. 2do. When the fame Song is to be performed by an Instrument and a Voice, or by Two Instruments in Unison, it may be required, for accommodating the one to the other, either to alter the Pitch of the Tuning, fo as the whole Notes may be equally lower or higher; or, because this is in some Cases inconvenient, and in others impossible, as when any Wind-instrument, as Organ or Flute, is to accompany a Voice, and the Note at which the Song is begun on the Instrument is too high or low for the Voice to carry it thro' in; in such Cases the only Remedy is to begin at another Note, from which, perhaps, you cannot proceed and find all the true Notes of the Song, for the Reasons set forth above; or let it be yet further illustrated by this Example. A Song is contrived to proceed thus, First, upward a tg. then a tl. then a Sem. &c. fuch a Progress is melodious, but is not to be found from any Note of the preceeding Scale, except c; and therefore we can begin only there unless the Infirument has other Notes than in the Order of the diatonick Scale.

We see then plainly the Desect of Instruments, whose Notes are fixt; and if this is curable, 'tis as plain that it can only be effected by inserting other Notes and Degrees betwixt these of the diatonick Series: How far this is, or may be obtained, shall be our next Enquiry; and the first Thing I shall do, is, to demonstrate that there cannot possibly be a perfect Scale fixed upon Instruments, i. e. such as from any Note Note upward or downward, shall contain any harmonical or concinnous Internal required in

their exact Proportions.

Since the Inequality of the Degrees into which the natural Scale is divided, is the Reason that Instruments having fixt Sounds are imperfect; for hence it is that all Intervals of an equal Number of Degrees, or whose Extremes comprehend an equal Number of Letters, are not equal; fo from C to E has Two Degrees, and E to G has as many; but the Degrees, which are the component Parts of these Intervals, differ, and so must the whole Intervals: Therefore it is manifest, that if there can be a perfect Scale (as above defined) fixt upon Instruments, it must be fuch as shall proceed from a given Sound by equal Degrees falling in with all the Divisions or Terms of the natural Scale, in order to preserve all its harmonious Intervals, which would otherwise be lost, and then it could be no musical Scale.

Ir such a Series can be found, it will be abfolutely perfect, because its Divisions falling in
with these of the natural Scale, each Degree
and Interval of this will contain a certain
Number of that new Degree; and therefore we
should have, from any given Note of this Scale,
any other Note upward or downward, which
shall be to the given Note in any Ratio of the
diatonick Scale; and consequently any Piece
of Melody might begin and proceed from any
Note of this Scale indifferently: But such a Division is impossible, which I shall demonstrate
thus.

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thus. 1mo. If any Series of Sounds is expressed by a Series of Numbers, which contain betwixt them the true Ratios or Intervals of these Sounds, then if the Sounds exceed each other by equal Degrees or Differences of Tune, that Series of Numbers is in continued geometrical Proportion, which is clear from what has been explained concerning the Expression of the Intervals of Sound by Numbers. 2do. Since it is required that the new Degree fought, fall in with the Divisions of the natural Scale, 'tis evident that this new Degree must be an exact Measure to every Interval of that Scale; that is. This Degree must be such, that each of these Intervals may be exactly divided by it, or contain a certain precise Number of it without a Remainder; and if no fuch Degree or common Measure to the Intervals of the natural Scale can be found, then we can have no fach perfect Scale as is proposed. But that such a Degree is impossible is easily proven; consider it must measure or divide every diatonick Interval, and therefore to prove the Impossibility of it for any one Interval is sufficient; take for Example the Tone 8:9, it is required to divide this Interval by putting in fo many geometrical Means betwixt 8 and 9 as shall make the Whole a continued Series, with these Qualifications, viz. That the common Ratio, (which is to be the first and common Degree of the new Scale) may be a Measure to all the other diatonick Inter-vals: But chiefly, 2do. Tis required that it be a rational Quantity, expressible in rational or known

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known Numbers. Now suppose one Mean, it is the square Root of 72 (viz. of 8 multiplied by 9) which, not being a square Number, has no square Root in rational Numbers; and universally, let n represent any Number of Means, the sufficient and least of them, is by an universal Theorem (as the Mathematicians know) thus express a significant to be any Number you please, since 9 is a significant Number of no Kind but a Square, therefore this Mean will in every Case be sure or irrational, and consequently the Tone 8:9 cannot be divided in the Manner proposed; and

fo neither can the diatonick Scale.

AGAIN, if the Division cannot be made in rational Numbers, we can never have a mufical Scale; for suppose that by some geometrical Method we put in a certain Number of Lines, mean Proportionals betwixt 8 and 9, yet none of these could be Concord with any Term or Note of the diatonick Scale; became the Coincidence of Vibrations makes Concord, but Chords that are not as Number to Number, can never coincide in their Vibrations, fince the Number of Vibrations to every Coincidence are reciprocally as the Lengths, which not being as Number to Number, they could not make a mufical Scale. In the last Place, Let us suppose the Interval 8:9 divided by any Number of fuch geometrical Means, and suppose (tho' absurd) that they make Concord with the rational Terms of the Scale, yet it is certain we could never and a common Measure to the whole Scale; for

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for every Term of a geometrical Series multiplied by the common Ratio, produces the next Term; but the Ratio here is a furd Quantity, viz. 8"x9 | 1 : 8, and therefore, tho it were multiplied in infinitum with any rational Number, could never produce any Thing but a Surd; and confequently never fall in with the Terms of the natural Scale: Therefore, fuch a perfect Series or Scale of fixt Sounds is impossible.

THO' the Defects of Instruments cannot be perfectly removed, yet they are in a good Meafure cured, as we shall presently see; in order to which let me premise, that the nearer the Scale in fixt Sounds, comes to an Equality of the Degrees or Differences of every Note to the next, providing always that the natural Intervals be preferved, the nearer it is to absolute Perfection; and the Defects that still remain after any Division, are less sensible as that Division is greater, and the Degrees thereby made fmaller and more in Number; but by making too many we render the Instrument impracticable; the Art is to make no more than that the Defects may be infenfible, or very nearly fo, and the Instrument at the same Time fit for Service.

I know that some Writers speak of the Division of the Octave into 16, 18, 20, 24, 26, 31, and other Numbers of Degrees, which, with the Extremes, make 17, 19, 21, 25, 27, and 32 Notes within the Compass of an Octave; but 'tis easily imagined how hard and difficult a Thing it must be to perform upon such an Instrument; suppose a Spinet, with 21 or 32 Keys

Keys within the Compass of an Octave; what an Embarassment and Confusion must this occafion especially to a Learner. Indeed if the Matter could not be tolerably rectified another Way, we should be obliged patiently to wrestle with fo hard an Exercise: But 'tis well that we are not put to fuch a difficult Choice, either to give up our Hopes of so agreeable Entertainment as mufical Instruments afford, or resolve to acquire it at a very painful Rate; no, we have it easier, and a Scale proceeding by 12 Degrees, that is, 13 Notes including the Extremes, to an Octave, makes our Instruments fo perfect that we have no great Reason to complain. therefore is the present System for Instruments, viz. betwixt the Extremes of every Tone of the natural Scale is put a Note, which divides it into Two unequal Parts called Semitones; and the whole may be called the femitonick Scale, containing 12 Semitones betwixt 13 Notes within the Compass of an Octave: And to preserve the diatonick Series distinct, these inserted Notes take the Name of the natural Note next below, with this Mark * called a Sharp, as CX or C sharp, to signify that it is a Semitone above C (natural;) or they take the Name of the natural Note next above, with this Mark L. called a Flat, as DV or D flat, to fignifie a Semitone below D (natural;) and tho' it be indifferent upon the main which Name is used in any Case, yet, for good Reasons, sometimes the one Way is used, and sometimes the other, as I shall have Occasion to explain: But that I T 2 may

may proceed here upon a fixt Rule, I denominate them from the Note below, excepting that betwixt A and B, which I always mark & fimply without any other Letter; understand the fame of any other Character of these Letters; as always when I name any Letters for Examples. I fay the fame of all the other Characters of these Letters, i. e. of all the Notes through the whole Scale that bear these Names; and thus the whole Oftave is to be expressed, viz. C. C*. D. D* E. F. F* G. G* A. J. B. C-

THE Keys of a Spinet represent this very distinctly to us; the foremost Range of continued Keys is in the Order of the diatonick Scale, and the other Keys fet backward are the artificial Notes.

Why we don't rather use 12 different Letters, will appear afterwards. The Two natural Semitones of the diatonick Scale being betwixt E F and AB flew that the new Notes fall betwixt the other natural ones as they are fet down. These new Notes are called accidental or fictitious, because they retain the Name of their Principals in the natural System: And this Name does also very well express their Defign and Use; which is not to introduce or serve any new Species of Melody diffinct from the diatonick Kind; but, as I have faid in the Beginning of this Chapter, to ferve the Modulation from one Key to another in the Course of any Piece, or the Transposition of the Whole to a different Pitch, for accommodating Instruments to a Voice, that beginning at a convenient Note, the Influment may accompany the Voice

Voice in Unison. How far the Luxury, if I may fo call it, of the present Musick is carried, fo as to change the Species of Melody, and bring in something of a different Character from the true Diatonick, and for that Purpose have Use for a Scale of Semitones, I shall have Occasion to speak of afterwards: But let us now proceed to shew how these Notes are proportioned to the natural ones, i. e. to shew the Quantity of the Semitones occasioned by these accidental Notes, and then see how far the System is perfected by them.

§ 2. Of the true Proportions of the Semitonick Scale, and how far the System is perfected by it.

THERE is great Variety, or I may rather call it Confusion, in the Accounts that Writers upon Musick give of this Matter; they make different Divisions without explaining the Reasons of them. But since I have so clearly explained the Nature and Design of this Improvement, it will be easy to examine any Division, and prove its Fitness, by comparing it with the End: And from the Things above said, we have this general Rule for judging of them, viz. That, the Division which makes a Series, from whose every Note we can find any diatonick Interval, upward or downward, with least and sewest Errors, is most perfect.

THERE are Two Divisions that I propose to explain here; and after these I shall explain the

ordinary and most approven Way of bringing Spinets and such kind of Instruments to Tune; and shew the true Proportion that such Tuning makes among the several Notes.

The first Division is this: Every Tone of the diatonick Series is divided into Two Parts or Semitones, whereof the one is the natural Semitone 15: 16, and the other is the Remainder of that from the Tone, viz. 128: 135 in the tg. and 24: 25 in the tl. and the Semitone 15: 16 is put in the lowest Place in each, except the tg. betwixt f and g, where 'tis put in the upper Place; and the whole Octave stands as in the following Scheme, where I have written the Ratios of each Term to the next in a Fraction set betwixt them below.

SCALE of SEMITONES.

c, c* . d. d*. e.f. f*. g, g*. a. V. b. cc. 15 128 15 24 15 128 15 15 24 15 128 15 16 135 16 25 16 135 16 16 25 16 135 16

It was very natural to think of dividing each Tone of the diatonick Scale, so as the Semitone 15:16 should be one Part of each Division; because this being an unavoidable and necessary Part of the natural Scale, would most readily occur as a sit Degree in the Division of the Tones thereof; especially after considering that this Degree 15:16 is not very far from the exact Half of a Tone. Again there must be some Reason for placing these Semitones in one Order rather than another, i. e. placing 15:16 uppermost in the Tone f:g, and undermost in

all the rest; which Reason is this, that hereby there are fewer Errors or Defects in the Scale; particularly, the 15: 16 is fet in the upper Place of the Tone f: g, because by this the greatest Error in the diatonick Scale is perfectly corrected, viz. the falfe 4th betwixt f and b upward, which exceeds the true harmonical 4th by the Semitone 128: 135, and this Semitone being placed betwixt f and fx, makes from fx to b a true 4th; and corrects also an equal Defect in the Interval b-f taken upward, which instead of a true 5th wants 128: 135, and is now just, by taking fx for f, that is, from up to fx is a just 5th. There were the same gross Errors in the natural 8ve proceeding from f, which are now corrected by the altered b viz. V, which is a true 4th above f. whereas b (natural) is to the f below as 32:45exceeding a true 4th by 128: 135; also from b (natural) up to f is a false 5th, as 45:64, but from V to f is a just 5th 2:3; and therefore respecting these Corrections of so very gross Errors, we fee a plain Reafon why the greater Semitone 15: 16 is placed betwixt f * and g, and betwixt a and V: For the Place of it in the other Tones, I shall only fay, in general, that there are fewer Errors as I have placed them than if placed otherwise; and I shall add this Particular, that we have now from the Key c both the diatonick Series with the 3d 1. and 3d g. and their Accompanyments all in their just Proportions, only we have 9: 16, viz. from c to b for the lesser 7th, which tho' it make not to many harmonious Relations to the other diatonick Notes as 5: 9 would do, yet confidering a 7th is still but a Discord, and for what Reason was made a greater Semitone 15: 16 above a. This 7th ought to be accounted the best here; vet the other 5:9 has Place in other Parts of the Scale; I shall presently shew you other Reasons why 9: 16 is the best in the Place where I have put it, viz. betwixt c and l.

CONCERNING this Scale of Semitones, Obferve 1mo, From any Letter to the same again comprehending Thirteen Notes is always a true 80e, as from c to c, or from c* to c*. 2do. We have Three different Semitones 15: 16 the greatest, 128: 135 the middle, and 24: 25 the leaft, which, when I have Occasion to speak of, I shall mark thus, fg. fm. fl. The first is the Difference of a 3d g and 4th; the fecond the Difference of tg. and fg. and the Third the Difference of t l. and f g. (or of 3d g. and 3d l. or 6th g. and 6th l.) 3tio. We have by this Division also Three different Tones, viz. 8:9 composed of fg. and fm. as c:d; then g:10composed of fg. and fl. as d; e; and 225: 256 composed of Two f g. as f * : g *, which occurs also betwixt b and cx, and no where elfe, all the rest being of the other Two Kinds which are the true Tones of the natural Scale. And the we might suppose other Combinations of these Semitones to make new Tones, yet their Order in this Scale affording no other, we are concerned no further with them. Now observe, this last Tone 225: 256 being equal to 2 / g.

must be also the greatest of these Three Tones; so that what is the greatest of the Two natural Tones, is now the Middle of these Three, and therefore when you meet with t.g. understand always the natural Tone 8:9, unless it be otherwise said.

4to. LET us now confider how the Intervals of this Scale shall be denominated; we have already heard the Reafon of these Names 3d 4th, 5th, &c. given to the Intervals of the Scale of Mufick; they are taken from the Number of Notes comprehended betwixt the Extremes (inclusive) of any Interval, and express in their principal Design, the Number of Notes from the Fundamental of an 8ve concinnously divided to any acute Term of the Series, tho' to make them of more univerfal Use they are also applied to the accidental Intervals. See Chap. 8. So that whatever Interval contains the fame Number of Degrees is called by the same Name; and hence we have some Concords some Difcords of the same Name; fo in the diatonick Scale, from c to e is a 3d g. Concord, and from e to g a 3d l. and from d to f is also called a 3d, because f is the 3d Note inclusive from d, yet it is Discord. See Chap. 8. If we consider next, that the Notes added to the Scale are not defigned to alter the Species of Melody, but leave it still diatonick, only they correct the Defects arising from fomething foreign to the Nature and Use of the Scale of Musick, viz. the limiting and fixing of the Sounds; then we fee the Reason why the same Names are still concontinued: And tho' there are now more Notes in an Octave, and so a greater Number of different Intervals, yet the diatonick Names comprehend the whole, by giving to every Interval of an equal Number of Degrees the same Name, and making a Distinction of each into greater and leffer. Thus an Interval of 1 Semitone is called a lesser Second or 2dl. of 2 Semitones is a 2dg. of 3 Semitones a 3dl. of 4, a 3dg. and so on as in this Table.

Denominations, 2dl. 2dg. 3dl. 3dg. 4th l. 4thg. 5th. 6th l. 6thg. 7th l. 7thg. 8ve. Num. of Sem. 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 11 - 12. In which we have no other Names, than thefe aheady known in the diatonick Scale, except the 4th greater, which for equal Reason might be called a 5th leffer, because 'tis a Middle betwixt 4th and 5th, i.e. betwixt 5 and 7 Semitones; and therefore we may call all Intervals of 6 Semitones Tritones (for 6 Semitones make 3 Tones) and these of 5 Semitones call them simply 4ths; and fo all the Names of the diatonick Scale remain unaltered, and we have only the Name of Tritone added, which yet is not new, for I have before observed, that it is used in the diatonick Scale, and thus all is kept very distinct; and if we proceed above an Octave, we compound the Names with an Octave and these below. Again take Notice, that as in the pure diatonick Scale, the Names of 3d, 4th, &c. anfwer to the Number of Letters which are betwixt the Extremes (inclusive) of any Interval, whereby the Denomination of the Interval is known, by knowing the Letters by which the

the Extremes of it are exprest, so in this new Scale the same will hold, by taking any Letter with or without the Sharp or Flat for the same Letter, and applying to the accidental Notes, in fome Cases the Letter of the Note below with a Sharp, and in others that of the Note above with a Flat: For Example. d*-g is a 3d, and includes 4 Letters; but if for dx we take el, then el-g, which is the same individual Interval, contains but 3 Letters; also if for I we take ax, then ax-cx, which is a true 3d l. includes 3 Letters, whereas V-c* has but Two. There is only one Exception, for the Interval b-f, which is a 4th g. contains 5 Letters, and cannot be otherwise exprest, unless you take ex which is equal to f natural; or take cl, which is equal to b natural; but this is not fo regular, and indeed makes too great a Confusion; tho' I have feen it so done in the Compositions of the best Masters, which yet will not make it reasonable, unless in the particular Case where 'tis used, it could not have been so conveniently ordered otherwise: But if we call the same Interval a 5th leffer, then the Rule is good; yet if we call every Tritone a 5th, we shall still have an Exception, for then f-b contains only 4 Letters; and therefore 'tis best to call all Intervals of 6 Semitones, Tritones, and then they are not subject to this Rule: In this therefore we see a Reason, why 'tis better that the accidental Note should be named by the Letter of the natural Note, than to make Twelve Letters in an O-Etave; besides, the Melody being still diatonick, thefe

these accidental Notes are only in place of the others; and by keeping the fame Names, we preserve the Simplicity of the System better.

5to. Having thus fettled the Denominations of the Intervals of this semitonick Scale, we must next observe, that of each Denomination there are Differences in the Quantity, arifing from the Differences of the Semitones of which they are composed, as is very obvious in the Scale: And these again may be distinguished into true and false, i. e. fuch as are either harmonical or concinnous Intervals of the natural Scale, and fuch as are not; and in each Denomination we find there is one that is true, and all the rest are false, except the Tritones which are all false, tho' they are used in some very particular Cases.

6to. Let us next enquire into all the Variety and the precise Quantity of every Interval within this new Scale, that we may thereby know what Defects still remain. We have already observed, that there are Three different Semitones and as many Tones; hence it is plain, there are neither more nor less than Three different 7ths of each Species, i. e. lesser and greater, which are the Complements of these Semitones and Tones to Octave, as here.

| Semin | t. 7t | bg. | 7th 1 | . Tone. | 10000 |
|-------|-------|------|--------|---------|-------|
| 15 | 16 - | 30 | f128 - | . Tone. | |
| 128 - | 135 - | 256> | 4 9 - | 16 - 18 | - |
| 24 - | 25 = | 48] | 5 = | 9 - 10 |) |

And to know where each of these 7ths lies, and all the Examples of each in the Scale, 'tis but taking all the Examples of these Semitones and Tones, which are to be found at Sight in the Scale marked with the Semitones, as you fee in Page 294. and you have the correspondent 7ths betwixt the one Extreme of that Semitone or Tone, and the Octave to the other Extreme. Then for the other Intervals, viz. 3ds, 6ths, 4ths, 5ths, which are harmonical, I have in the Table-plate, Fig. fet all the Examples of fuch of them as are false, with their respective Ratios; and with the Ratios of the 6th and 5th I have fet an e or d, to fignify an excessive, or a deficient Interval from the true Concord; and confequently their correspondent 3ds and 4ths will be as much on the contrary deficient or All the rest of the Intervals of these excessive. feveral Denominations, containing 3, 4, 5, 7, 8 or 9 Semitones, are true of their several Kinds, whose Ratios we have frequently feen, and fo, they needed not be placed here. Then for the Tritones, you have in the last Part of the Table all their Variety and Examples; by the Nature of this Interval it exceeds a true 4th, and wants of a true 5th; you'll eafily find the Difference by the Ratio.

Now we have feen all the Variety of Intervals in this new Scale; and by what's explain'd we know where all the Extremes of each ly; and it will be eafy to find the true Ratio of any Interval; the Letters or Names of whose Extremes in the Scale are given, viz. by finding in

the Scale how many Semitones it contains, and thereby the Denomination of it, by which you'll find its Ratio in the preceeding Table, unless it be a true Concord, and then it is not in the Table. which is a Sign of its being true. And as to this Table, observe, that I have no Respect to the different Characters of Letters, and you must suppose every Example to be taken up-ward in the Scale, from the first Letter of the Example to the fecond, counting in the natutal Order of the Letters.

7mo. We are now come to consider how far the Scale is perfected; and first observe, that there are no greater or lesser, and precisely no other Errors in it, than the Differences of the Three Semitones, which are these following;

of which $\begin{cases} fg. \text{ and } fm. = 2025 : 2048 \\ fm. \text{ and } fl. = 80 : 81 \\ fg. \text{ and } fl. = 125 : 128 \end{cases} \text{ the leaft,}$ and the

lower the greatest Error. In the diatonick Scale fome Intervals erred a whole Semitone, and all the rest only by a Comma 80:81; here we have one Error a very little greater, and another leffer: All the 5ths and 4ths except Three, are just and true; of the 3dl. and 6th g. there are as many true as false; and of the 3dg. and 6th l. we have Five falle and Seven true. These Errors are fo fmall, that in a fingle Cafe the Ear will bear it, especially in the imperfect Concords of 3d and 6th; but when many of these Errors happen in a Song, and especially in the prin-

the

principal Intervals that belong to the Key, it will interrupt the Melody, and the Instrument will appear out of Tune (as it really is with respect to that Song:) But then we must observe, that as the Order of these Semitones is different in every Octave, proceeding from each of the Twelve different Keys or Letters of the Scale; to we find that some Songs will proceed better, if begun at some Notes, than at others. If we compare one Key with another, then we must prefer them according to the Perfection of their principal Intervals, viz. the 3d, 5th and 6th, which are Essentials in the Harmony of every Key: And let any Two Notes be proposed to be made Keys of the same Species, viz. both with the 3dl, &c. or 3dg, &c. We can eafily find in the preceeding Table what Intervals in the Scale are true or false to each of them; and accordingly prefer the one or the other: But I shall proceed to

The fecond Division of the 8ve into Semitones which I promised to explain, and it is this: Betwixt the Extremes of the tg. and tl. of the natural Scale is taken an harmonical Mean which divides it into Two Semitones nearly equal, thus, the tg. 8:9 is divided into Two Semitones which are 16:17 and 17:18, as here 16:17:18, which is an arithmetical Division, the Numbers representing the Lengths of Chords; but if they represent the Vibrations, the Lengths of the Chords are reciprocal, viz. as 1:16:3 which puts the greater Semitone 16 next the lower Part of the Tone, and the lesser 16 next

| c.c. d. d. | €. € | .f | f*. | g . g | * . a | . 1 | 6 | .c |
|------------|------|-------|-----|-------|-------|-----|----|----|
| 16 17 18 | 19 1 | 15 16 | 17 | 18 | 19 | 16 | 17 | 15 |
| 17 18 19 | 20 1 | 16 17 | 18 | 19 | 20 | 17 | 18 | 16 |

In this Scale we have these Things to observe, 1 mo. That every Tone is divided into Two, Semit. whereof I have set the greater in the lowest Place. 2do. We have hereby Five different Semitones; out of which as they stand in the Scale we have Seven different Tones, as here.

Sem. Tones.

16 $+ \frac{17}{18} = \frac{8}{9}$ 17 $+ \frac{18}{18} = \frac{17}{19}$ 18 $+ \frac{19}{19} = \frac{9}{10}$ 19 $+ \frac{15}{16} = \frac{57}{16}$ 15 $+ \frac{16}{17} = \frac{15}{85}$ 17 $+ \frac{15}{18} = \frac{85}{96}$

Considering how, by a harmonical Mean, the 8th, 5th, and 3dg. were divided into their harmonical or concinnons Parts, it could not but readily occur to divide the Tones the same Way, when a Division was found necesfary; but we are to confider what Effect this Division has for perfecting of Instruments. It would be more troublefom. than difficult to calculate a Table of all the Variety of Ratios contain'd in this Scale; I shall leave you to this Exercite for your Diversion, and only tell you here, that having

ving calculate all the 5ths and 4ths, I find there are only Seven true 5ths, and as many 4ths, whereas in the former Scale there were Nine; and then for the Errors, there are none of them above a Comma 80:81; in short, there is one false 5th and 4th whose Error is a Comma, and the rest are all very much less; and, the there are fewer true 5ths and 4ths here, yet the Errors being far less and more various, compensate the other Loss: As to the 3ds and 6ths, there are also here more of them false than in the preceding Scale, for of each there are but Four true Intervals, but the Errors are generally much less, the greatest being far less than

the greatest in the other Scale.

I shall fay no more upon this, only let you know, That Mr. Salmon in the Philosophical Transactions tells us, That he made an Experiment of this Scale upon Chords exactly in these Proportions, which yielded a perfect Confort with other Instruments touched by the best Hands: But observe, that he places the leffer Semit. lowest, which I place uppermost; and when I had examined what Difference this would produce, I found the Advantage would rather be in the Way I have chosen. And this brings to mind a Question which Mr. Simpson makes in his Compend of Musick, viz. Whether the greater or lesser Semitone lies from a to Li he fays 'tis more rational to his Understanding. that the leffer Semitone ly next a; but he does not explain his Reason; he speaks only of the arithmetical Division of a Chord into equal Parts.

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Parts, but has not minded the harmonical Division of an Interval, by which we have seen the diatonick Scale so naturally constituted, whereby the greater Part is always laid next the gravest Extreme: But in short, when we speak of the Reason of this, we must consider the Design of these Semitones, and which one in such a Place answers the End best, and then I believe there will be no Reason found why it should be as Mr. Simpson says, rather than the other Way.

demonstrating the Proportions that occur in it; and of the Pretence of a nicer Method considered.

Subject, was to explain the ordinary. Way of tuning Spinets and that Kind of Instruments; for whether it be, that the tuning them in accurate Proportions in the Manner mentioned is not eatily done, or that these Proportions do not sufficiently correct the Desects of the Instrument, there is another Way which is generally followed by practical Musicians; and that is Tuning by the Ear, which is sounded upon this Supposition, that the Ear is perfectly Judge of an 8ve and 5th. The general Rule is, to begin at a terrain Note as c, taken toward the Middle of the

the Instrument, and tuning all the 8ves up and down, and also the 5ths, reckoning Seven Semitones to every 5th, whereby the whole will be tuned; but there are Differences even in the

Way of doing this, which I shall explain.

SOME and even the Generality who deal with this Kind of Instrument, tune not only their Octaves, but also their 5ths as perfectly Concord as their Ear can judge, and confequently make the 4ths perfect, which indeed makes a great many Errors in the other Intervals of 3d and 6th (for the discord Intervals, they are not fo confiderable;) others that affect a greater Nicety pretend to diminish all the 5ths, and make them deficient about a Quarter of a Comma, in order to make the Errors in the rest fmaller and less sensible: But to be a little more particular, I shall shew you the Progress that's made from Note to Note; and then confider the Effect of both thefe Methods. In order to this, let us view again the Scale with its 12 Semitones in an Octave; but we have Use for Two Octaves to this Purpose. Then two. Beginning at c take it at a certain Pitch, and time all its Octaves above and below; then 2do. Tune g a 5th above c, and next tune all the Oftaves of g; stio. Take d a 5th above g, and then tune all the Octaves of d. 410. Take a a 5th above d, then tune all the Otages of a. 5to. Take e a 5th above a, and tune all the Octaves of e. Then, 6th. Take b (natural) a 5th above e, and tune all the O-Staves of 1. 7mo. Take fx. a 5th above by then

then tune all the Octaves of fx. 8vo. cx a sthe above fx, and then all the Octaves of cx. 9no. Take gx a 5th above cx, then all its Octaves, and having proceeded fo far, we have all the Keys tuned except f, dx, and l; for which, 10mo. Begin again at c, and take f a 5th downward, then tune all the fs. 11mo. Take 1 a 5th downward to f, and tune all the Us. Laftly. Take d *a 5th below 1, and then tune all the Octaves of dx; and so the whole Instrument is in Tune. And observe, That having tuned all the Octaves of any Key, the next Step being to take a 5th to it, you may take that from any of the Keys of that Name.

Now supposing all these Octaves and 5ths to be in perfect Tune, we shall examine the Effects it will have upon the rest of the Intervals; and in order to it, I have exprest this Tuning in Plate 1. Fig. 6. by drawing Lines betwixt every Note, and another, according to the Method of Procedure; but I have only marked the 5ths, supposing the Octaves to be tuned all along as you proceed; then I have marked the Progress from 5th to 5th by Numbers fet upon them to signify the 1st, 2d, &c. Step; and in the Method there taken you fee all the Notes tuned from c to fx above its Octave: We suppose all the other Notes above and below in the Instrument to have been tuned by Octaves to these, but for the Thing in Hand we have Use for no more of the Scale. Observe next, That I have marked the Semitones betwixt every Note by the Letters g, l. 21%.

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wiz. greater and lesser; for there are only Two Kinds in this Scale, as we shall presently see, and also what they are, for the natural Sem. 15:16 is not to be found here; and while I speak of this Scale and of Semitones greater and lesser, I mean always these Two, unless it be

faid otherwise.

Ir we find the Degrees of this Scale in the Tones or Semitones, we shall by these easily-find the Quantity of every other Interval; and in the following Calculations I take all the Examples upward from the first Letter named, and therefore I have made no Distinction in the Character of the Letters: To begin, from c to g is a 5th 2:3, and from g to d a 5th, therefore from c to d is Two 5ths 4:9; out of this take an Octave, the Remainder is 8:9 a tg. and consequently c-d is a tg. 8:9; by this Method you'll prove that each of these Intervals marked in the following Table is a tg. 8:9. In the next Place, consider, from a to e is a 5th, therefore from e to a is a 4th: But

c - e f * g g a b c

All greater Tones 8:9

from f to a there are Two tg as in the preceding Table, whose Sum is 64:81, which taken from a 4th 3:4, leaves this Semitone 243:256 for e:f (which is less than 15:16 by a Comma) then if we substract this from a Tone 8:9, it leaves 2048: 2187, a greater Semitone than the former, and if we mark the one l. and the other g, all the U 3 Semitones from d to a, will be as I have marked them in the Fig. referred to; for fince e: fis a tg. and e.f is a fl. therefore f.f* is a fg. and so of the rest, every Two Semitones from d to a being a tg. Again fince f - c is a 5th, and also e - b, taking away what's common to both, viz. f - b, there remains on each Hand these equal Parts e . f and b . c, fo that b . c is also afl. and fince l:c is a tg. and b, c afl. l. b must be a fg. and also a . v a fl. because a: b is a tg. Next, from c* to g* is a 5th, also from dx to 1, and taking away dx-gx out of both, there remains cx: dx equal to gx-1, which contains Two sl. but d. d* is already found to be a fl. therefore c* . d is /l. and c: d being a tg. c.c* must be a fg.

THUS we have discovered all the Semitones within the Octave; of which as they stand in the Scale, we have only Two different Tones, viz. the t g. 8: 9 and another which is leffer 59049: 65536 composed of Two of the lesser Semitones, as you fee betwixt con and also betwixt g*: 1; in every other Place of

the Scale it is a tg.

LET us next consider the other Intervals, and first. We have all the Octaves and 5ths perfect except the 5th g* - d* which is 531441: 786432, wanting of a true 5th more than a Comma, viz. the Difference of the fg. and fl. as is evident in the Scheme, for g - d is a true 5th but the Interval g* - d is common to g - d, and grand heing taken from both,

leaves in the first the fg. g. g*, and in last the (1. d. d*; then all the 4ths are of confequence perfect, except dx - gx, which exceeds as much as its correspondent 5th is deficient. But Lastly, For the 3ds and 6ths they are all false, plainly for this Reason, that in the whole Series there is no lesser Tone 9: 10. which with the tg. 8:9 makes a true 3d g. nor any of the greater Semitone 15: 16, which with tg makes a 3dl. And for the Errors they are easily discovered, in the 3d g. (and the Correspondent 6 1:) the Error is either an Excess of a Comma 80: 81 the Difference of tg. and tl. of the natural Scale; which happens in these Places where Two tg. stand together, as in the 3d g. from c to e; or it is a Deficiency equal to the Difference of the lesser Tone 9; 10, and the Tone above mentioned 59049: 65536, which Tone is less than 9: 10 by this Difference 32768, 32805 (as in the 3d g. cm! f) which is greater than a Comma; and for the 3d l. (and its 6th g.) it has the same Errors, and is either deficient a Comma, viz. the Difference of the fg. 15:16 and the fl. 2431 256, as in the 3d l. c: dx, or exceeds by the Difference of the new /g. 2048: 2187 and the Ig. 15: 16 which is less than the other by this Difference 32768: 32805 which is greater than a Comma.

Now the 5ths and 4ths are all perfect but one, yet the 3ds and 6ths being all falle, there is no Note in all the Scale from which we have a true diatonick Series; and the Er-

Jors being equal to a Comma in some and greater in others, makes this Scale less perfect than any yet described; at least than the first Division explained, in which there were only 3 false 5tbs, whereof Two err by a Comma, and the other by a lesser Difference; and having many true 3ds and 6ths, feems plainly a more perfect Scale. These Errors may still be made less by multiplying the artificial Keys, and placing them betwixt fuch Notes of the preceeding Scale as may correct the greatest Errors of the most usual Keys of the diatonick Series, and of fuch Divisions you have Accounts in Mersennus and Kircher; but a greater Number than 13 Keys in an Octave is fo great a Difficulty for Practice, that they are very rare, and our best Compolitions are performed on Instruments with 13 Notes in the Octave, and as to the tuning of these,

LET us now consider the Pretences of the nicer Kind of Musicians; they tell us, That in tuning by Octaves and 5ths, they diminish all the 5ths by a Quarter of a Comma, or near it (for the Ratio 80: 81 cannot be divided into 4 equal Parts, and exprest in rational Numbers) in order to make the Errors through the whole Instrument very fmall and infenfible. I shall not here trouble you with Calculations made upon this Supposition, because they can be easily done by those who understand what has been hitherto explained upon this Subject; therefore I fay no more but this, That it must be an extraordinary Earthat can judge exactly of a Quarter Comma, and I shall

shall add, That some Practifers upon Harpsichords have told me they always tune their 5ths perfect, and find their Instrument answer very well. 'Tis true they cannot deny that the fame Song will not go equally well from every Key, which argues still the Imperfection of the Instrument; but there is no Song but they can find some Key that will answer. If a very just and accurate Ear can diminish the Errors, so as to make them yet finaller and more equal thro' the whole Instrument, I will not fay but they may make more of the Octaves like other, and confequently make it an indifferent Thing which of these Keys, that are brought to such a Likeness, you begin your Song at; but even these cannot deny that a Song will do better from one Key than another; fo that the Defects are not quite removedeven as to Sense.

DR. Wallis has a Discourse in the Philosophical Transactions concerning the Imperfection of Organs, and the Remedy applied to it; the Imperfection he observes is the same I have already spoken of viz. That from every Note you cannot find any Interval in its just Proportion. "Tis true indeed the Doctor only considers the Imperfection of a Scale of Semitones, and particularly one constituted in the Ratio of the 2d Kind of Division abovementioned; he does not fay directly for what Reasons a Scale of Semitones was necessary; but, as if he supposed that plain enough, he fays there are still some Defects. and therefore, fays he, Instead of these Proportions (of the Semitones) it is fo ordered, if I mistake

mistake not the Practice, that the 13 Pipes within an Octave, as to their Sounds, with respect to acute and grave, shall be in continual Proportion, whereby it comes to pass that each Pipe doth not express its proper Sound, but something varying from it, which is called Bearing; and this, says he, is an Imperfection in this noble Instrument. Again, he fays, That the Semitones being all made equal, they do indifferently answer all Positions of mi (i.e. of the Two natural Semitones in an Octave; of the Use of this Wordmi, we shall hear again) and tho' not exactly to any, yet nearer to some than to others; whence it is that the same Song stands better in one Key than another. I have shewn above, that a Scale of Degrees accurately equal, which will coincide with the Terms of the natural Scale is not possible; and now let me fay, That tho' the Octave may be divided into 12 equal Semitones by geometrical Methods, that is, 13 Lines may be constructed, which shall be in continued geometrical Proportion, and the greatest to the least be as 2 to 1, yet none of these Terms can be exprest by rational Numbers, and fo 'tis impossible that such a Scale could express any true Musick, and hence I conclude, that this Bearing does not make the Semitones exactly equal, tho' they may be fenfiby fo in a fingle Comparison of one with another; and supposing them equal, the Doctor fays the same Song will stand better at one Key than another; which may be very true, because none of the Terms of such a Scale can pollibly

possibly fall in with these of the natural Scale, which are all exprest by rational Numbers, and the other are all Surds; whereas had we a Scale of equal Degrees, coinciding with the natural Scale, every Key would necessarily be alike for every Song. These Imperfections, fays the Doctor, might be further remedied by multiplying the Notes within an Octave, yet not without something of bearing, unless to every Key (he means of the Seven natural ones) be fitted a distinct Scale or Set of Pipes rising in the true Proportions, which would render the Instrument impracticable; But even this I think would not do; for let as suppose that from any one Key as c, we have a Series of true diatonick Notes, in both the Species of Sharp and flat Key, let a Song be begun there as the principal Key, and suppose it to change into any or all of the consonant Keys within that Octave, then 'tis plain that if a Series is fitted to all these natural Notes of the Key c, the Instrument is so perfected for c, that any Piece of true diatonick Musick may begin there; but suppose, for the Accommodation of one Instrument to another, we would begin the Piece in g, 'tis plain this cannot be done with the same Accuracy as from c perfected as we have supposed, unless to these Notes that proceed concinnously from g, and are now confidered as the natural Notes of that Key, be also fitted other Scales for answering the Modulations of the Song from the principal Key (which is now g) to the other confonant Keys. And if we should but perfect Two Keys of § 4. A brief Recapitulation of the preceeding Sections.

THE Amount of all that has been faid upon this Subject of the System of Musick, with respect to Instruments having fixt Sounds, is in short this. 1mo. Because the Degrees of the true natural. diatonick Scale are unequal; fo that from every Note to its Offave contains a different Order of Degrees; therefore from any Note we cannot find any Interval, in a Series of fixt Sounds constituted in these Ratios; which yet is ne-cessary, that all the Notes of a Piece of Musick which is carried thro' feveral Keys, may be found in their just Tune; or that the same Song may be begun indifferently at any Note, as will be necessary or at least very convenient for accommodating fome Instruments to others, or these to the human Voice, when it is required that they accompany each other in Unison. 2do. 'Tis impossible that fuch a Scale can be found; yet Infruments are brought to a tolerable Perfection, by dividing every Tone into Two Semitones, making of the whole Octave 12 Semitones, which in a fingle Cafe are fenfibly equal

qual. 3tio. These Semitones may be made in exact Proportions, according to the Methods above explained; or the Instrument tun'd by the Ear, as is alfo explained, which reduces all to the particular Kinds of Degrees and Order also shown above. 4to. The diatonick Series, beginning at the lowest Note, being first settled upon any Instrument, and distinguished by their Names a.b.c.d. e.f.g. the other Notes are called fictitious Notes, taking the Name or Letter of the Note below with a * as c*, fignifying that 'tis a Semitone higher than the Sound of c in the natural Series, or this Mark I with the Name of the Note above fignifying a Semitone lower, as d 1; which are necessary Notes in a Scale of fixt Sounds, for the Purpofes mentioned in the last Article; what Reasons make them to be named fometimes the one, fometimes the other Way shall be shewn afterwards; and observe. that fince there is no Note betwixt e and f. which is the natural Semitone, therefore f cannot be marked &, for with that Mark it would be e; nor can e be marked *, which would raile it to f; but e is capable of a 1, as f is of a *. So b. c being the other natural Semitone. b is incapable of a *, which would make it coincide with c, but it properly takes a 1, and when this Mark is fet alone it expresses flat b. again c receives not a b, for e b is equal to b natural, but it takes a *. All the rest of the Notes d.g. a are made either / or * because they have a Tone on either Hand above and below. Hence it is, that b and e are faid to be naturally

naturaly sharp, as c and f naturally flat; and yet in some Cases I have seen c and f marked la and b and e marked *, which makes these Letters fo marked coincide with the natural Notes next below and above. 3tio. Because the Semitones are very near equal, therefore in Pra-Etice (upon fuch Instruments at least) they are all accounted equal, fo that no Distinction is made of Tones into greater and lesser; and for the other Intervals they are also considered here without any Differences, every Number of Semitones having a distinct Name, according to the Rule already laid down; and therefore when a true 3d or 4th, &c. is required from any Note, we must take so many Semitones as make an Interval of that Denomination in general, which will in some Cases be true, and in others a false Interval, and cannot be otherwise in such Instruments. 4to. The Differences among the Semitones, in the best tuned Instruments, is the Reason that a Song will go better from one Note or Key of the Instrument than another; because the Errors occur more frequently in fome Combinations and Successions of Notes than in others; and happen also in the more principal Parts of one Key than another.

AND because the Delign of these new Notes is not to alter the Species of the true diatonick Melody, but to correct the Defects arising not from the Nature of the System of Musick it felt, but the Accident of limiting it to fixt Sounds; therefore beginning at any Note, if we take an 8ve concinnously divided by Tones and Semitones in the diatonick Order (which will be found more exact from some Notes than others because of the small Errors that still remain) that may be justly called a natural Series, and all these Notes natural Notes with respect to the First or Fundamental from which they proceed; and yet in the common Way of fpeaking about these Things, no 8ve is called a natural Key that takes in any of these Notes marked * or /, in order to make it a concinnous Series. And, as I have observed in another Place, there is no Key called natural in the whole Scale but C and A. I have also explained that there are properly but Two Kinds of Keys or Modes, the greater with the 3d g, &c. as in the 8ve C, and the leffer with the 3d 4 &c. as in A; but whenever in any System of fixt Sounds we can find a Series that is a trueKey or fo nearthat we take it for one)there is no other Reason of calling that an artificial Key, than the arbitrary Will of those who explain these Things to us, unless they make the Word attificial include the Imperfections of these Keys, which I believe they don't mean, because they suppose the Errors are inconsiderable; for with respect to the Tune or Voice, 'tis equally a natural Key, begin at what Pitch you will; and we can suppose one Instrument so tuned as to play along Unifon with the Voice, and be in a natural Key, and in another fo tuned as that, to go unifon with the same Voice, it must take an artificial Key: But I shall have Occasion to consider this again in the next Chapter, where

I shall also shew you what Letters or Notes must be taken in to make a true diatonick Scale of either Species proceeding from any one of the Twelve different Letters in this new Scale.

THE diatonick Series upon all Instruments. being kept distinct by the Seven distinct Letters, is always first learned; and because in every 8ve of the diatonick Scale, there are Two Semitones distant one from another by 2 Tones or 3, therefore if the first 8ve of the diatonick Series upon any Instrument is learned, by the Place of the Two Semitones, we shall easily know how we ought to name the first and lowest Note; for if the 3d and 7th Degrees are Semitones, then the first Note is c, if the 2d and 6th then it is d, and fo of the rest, which are eafily found by Inspection into a Scale carried to Two 8ves. And different Inftruments begin at [i. e. their lowest Note is named by] different Letters; in some Cases because the natural Series, which is always most considerable, is more eafily found if we begin with one particular Order of the Degrees; and in other Cafes the Reason may be the making one Instrument concord to another. So Flutes begin in f, Hautboys, Violins, and some Harpsichords begin in g, tho the last may be made to begin in any Letter. As to the Violin, let me here observe, that it is a Kind of mixt Instrument, having its Sounds partly fixed and partly unfixed: It has only Four fixt Sounds, which are the Sounds of the Four Strings untouched by the Finger, and are called g-d-a-e. and can with very finall Trouble

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Trouble be altered to a higher or lower Pitch, which is one Conveniency; all the rest of the Notes being made by fhortning the String with one's Finger, are thereby unfixed Sounds, and a good Ear learns to take them in perfect Tune with respect to the preceeding Note; fo that from any Note up or down may be found any Interval proposed; and therefore we may begin a Song at any Note, with this Provision that it be most easy and convenient for the Hand; yet a Habit of Practice in every Key may make this Condition unnecessary. There is only this one Variation to be observed, that by making the Four open Strings true 5ths, all continuous, d-a is here a true 5th, which in the diatonick Series wants a Comma; from this follow other Variations from the Order of the diatonick Scale; as here, from g (the first Note of the 4th String) to a is made a greater Tone, that it may be a true 8ve below a the first Note of the 2d String, which is occasioned by making d-a a true 5th, whereas in the Scale g-a is a lesser Tone: And fo from a to b will be made a leffer Tone, tho 'tis t g. in the Scale, that g-b may be made a true 3d g. which are Advantages when we begin in g. The same happens in the 3d String, whose first Note is d, from which to the next Note e will be made a tg. that it may be an 8ve to the first Note of the first String, yet d:e in the Stale is a tl. Again, if having made d-f on the 3d String a true 3d 1. we would rife to a true 5th above d, 'tis plain f: g must be a th. to make g. a true 4th to d, and then g: a will FIAY-

be a tg, because d-a is a 5th in this Tuning; which is plainly inverting the Order of the Scale, for there f: g is tg. and g: a a tl. but still this is an Advantage, that we can express any Order of Degrees from any Note; fo that sometimes we can make that a t g. which at other times the Melody requires to be a tl. Yet let me observe in the last Place, that if all these intermedia e Notes betwixt the open Sounds of the Four Strings, be constantly made in the fame Tune, they become thereby fixt Sounds; and this Instrument will then have as great Imperfections as any other; and indeed confidering that the stopping of the String to take these Notes in Tune is a very mechanical Thing, at least the doing of it right in a quick Succession of Notes must proceed altogether from Habit, tis probable we take them always in the fame Tune; nor do I believe that any Practifer on this Instrument dare be very positive on the contrary; yet I don't fay 'tis impossible to do otherwife, for I know a Habit of playing the fame Piece in leveral Keys might make one fensible of the contrary, if observed with great Attention; and upon the larger Instruments of this Kind, that have Frets upon the Neck for directing to the right Note, it would be very fenfible; and even upon the Violin, we find that some Songs go better from one Key than another; which proves that those at least to whom this happens, take these Notes always in the same Tune, ed flore a the plain of the stock was an

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HAVING done what I proposed for explaining the Theory of Sounds with respect to Tune, the Order seems to require, that I should next consider that of Time; but the this be very considerable in Practice, yet there is much less to be said about it in Theory; and therefore I chuse to explain next the Art of writing Mussick, where I shall have Occasion to say what is needful with respect to the TIME.

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The Method and Art of Writing Musick, particularly how the Differences of Tune are represented.

I . A general Account of the Method.

plained in Chap. 1. S 2. And to come to the Thing it felf, let us consider.

It was not enough to have discovered so much of the Nature of Sound, as to make it serviceable to our Pleasure, by the various Combinations

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binations of the Degrees of Tune, and Measures of Time; it was necessary also, for enlarging the Application, to find a Method how to represent these fleeting and transient Objects, by fensible and permanent Signs; whereby they are as it were arrested; and what would otherwise be lost even to the Composer, he preserves for his own Use, and can communicate it to others at any Distance; I mean he can direct them how to raife the like Ideas to themselves, supposing they know how to take Sounds in any Relation of Tune and Time directed; for the Business of this Art properly is, to represent the various Degrees and Measures of Tune and Time in such a Manner, that the Connection and Succession of the Notes may be easily and readily discovered, and the skilful Practifer may at Sight find his Notes, or, as they freak, read

As the Two principal Parts of Musick are the Tune and Time of Sounds, so the Art of writing it is very naturally reduced to Two Parts corresponding to these. The first, or the Method of representing the Degrees of Tune, I shall explain in this Chapter; which will lead me to say something in general of the other, a more full and particular Account whereof you shall

have in the next Chapten

We have already seen how the Degrees of Tune or the Scale of Musick may be exprest by 7 Letters repeated as oft as we please in a different Character; but these, without some other Signs, do not express the Measures of Time, unless we suppose all the

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the Notes of a Song to be of equal Length. Now, supposing the Thing to be made not much more difficult by these additional Signs of Time, yet the Whole is more happily accom-

plished in the following Manner,

IF we draw any Number of parallel Lines, as in Plate 1. Fig. 7. Then, from every Line to the next Space, and from every Space to the next Line up and down, represents a Degree of the diatonick Scale ; and confequently from every Line or Space to every other at greater Distance represents some other Degree of the Scale, according as the immediate Degrees from Line to Space, and from Space to Line are determined. Now to determine these we make Use of the Scale exprest by 7 Letters, as already explained, viz. c:d; e.f:g;a:b c- where the Tone greater is represented by a Colon (:) the Tone leffer by a Semicolon (;) and the Semitone greater by a Point (.). If the Lines and Spaces are marked and named by these Letters, as you see in the Figure, then according to the Relations affigned to thefe Letters (i. e. to the Sounds exprest by them) the Degrees and Intervals of Sound exprest by the Distances of Lines and Spaces are determined.

As to the Extent of the Scale of Musick, it is infinite if we confider what is fimply possible, but for Practice, it is limited; and in the prefent Practice 4 Octaves, or at most 4 Octaves with a 6th, comprehending 34 diatonick Notes, is the greatest Extent. There is scarcely

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tho' feveral different Voices may; nor any one fingle Piece of Melody, that comprehends fo great an Interval betwixt its highest and lowest Note; Yet we must consider not only what Melody requires, but what the Extent of several Voices and Instruments is capable of, and what the Harmony of severals of them requires; and in this respect the whole Scale is necessary, which you have represented in the Figure directed to; I shall therefore call it the universal System, because it comprehends the whole Extent of modern Practice.

But the Question still remains, How any particular Order and Succession of Sounds is represented? And this is done by setting certain Signs and Characters one after another, up and down on the Lines and Spaces, according to the Intervals and Relations of Tune to be exprest; that is, any one Letter of the Scale, or the Line or Space to which it belongs, being chosen to set the first Note on, all the rest are fet up and down according to the Mind of the Composer, upon such Lines and Spaces as are at the designed Distances, i. e. which express the designed Interval according to the Number and Kind of the intermediate Degrees; and mind that the first Note is taken at any convenient Pitch of Tune; for the Scale, or the Lines and Spaces, ferve only to determine the Tune of the rest with relation to the first, leaving us to take that as we please: For Example, if the first Note is placed on the Line c, and ed by greaten batent. Those is fearcely any

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the next designed a Tone or 2d g. above, it if fet on the next Space above, which is d; or i. it is designed a 3d g. it is set on the Line above which is e; or on the fecond Line above, if it was defigned 5th, as you fee represented in the 2d Column of the Scale in the preceeding Figure, where I have used this Character O for a Note. And here let me observe in general; that these Characters serve not only to direct how to take the Notes in their true Tune, by the Distance of the Lines and Spaces on which they are fet; but by a fit Number and Variety of them, (to be explained in the next Chapter) they express the Time and Measure of Duration of the Notes; whereby 'tis plain that thefe Two Things are no way confounded; the relative Measures of Tune being properly determined by the Distances of Lines and Spaces, and the Time by the Figure of the Note or Character.

Tis easy to observe what an Advantage there is in this Method of Lines and Spaces, even for fuch Musick as has all its Notes of equal Length, and therefore needs no other Thing but the Letters of the Scale to express it; the Memory and Imagination are here greatly affifted, for the Notes standing upward and downward from each other on the Lines and Spaces, express the rising and falling of the Voice more readily than different Characters of Letters; and the Intervals are also more readily ratural cono la X 42di ed et idgue OF

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OBSERVE in the next Place, That with respect to Instruments of Musick, I suppose their Notes are all named by the Letters of the Scale, having the fame Diffances as already stated in the Relations of Sounds exprest by these Letters; so that knowing how to raise a Series of Sounds from the lowest Note of any Instrument by diatonick Degrees (which is always first learned) and naming them by the Letters of the Scale, 'tis easily conceived how we are directed to play on any Instrument, by Notes set upon Lines and Spaces that are named by the fame Letters. It is the Businels of the Masters and Profesors of several Instruments to teach the Application more expresly. And as to the buman Voice, observe, the Notes thereof, being confined to no Order, are called c or d, &c. only with respect to the Direction it receives from this Method; and that Direction is also very plain; for having taken the first Note at any convenient Pitch, we are taught by the Places of the rest upon the Lines and Spaces how to tune them in relation to the first, and to one another.

Again, as the artificial Notes which divide the Tones of the natural Series, are exprest by the same Letters, with these Marks, **, **, already explained, so they are also plac'd on the same Lines and Spaces, on which the natural Note named by that Letter stands; thus c** and c belong to the same Line or Space, as also d' and d. And when the Note on any Line or Space ought to be the artificial one, it is marked

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ked * or 1; and where there is no fuch Mark it is always the natural Note. Thus, if from a (natural) we would fet a 3dg. upward, it is cox; or a 3dl, above g, it is b flat or 1, as you fee in the 2d Column of the preceeding Figure. These artificial Notes are all determined on Instruments to certain Places or Positions, with respect to the Parts of the Instrument and the Hand; and for the Voice they are taken according to the Distance from the last Note, reckoned by the Number of Tones and Semitones that every greater Interval contains.

THE last general Observe I make here is, that as there are Twelve different Notes in the femitonick Scale, the Writing might be fo ordered, that from every Line a Space to the next Space or Line should express a Semitone; but it is much better contrived, that thefe should express the Degrees of the diatonick Scale (i.e. some Tones some Semitones) for hereby we can much easier discover what is the true Interval betwixt any Two Notes, because there' are fewer Lines and Spaces interpofed, and the Number of them fuch as answers to the Denomination of the Intervals; fo an Octave comprehends Four Lines and Four Spaces; a 5th comprehends Three Lines and Two Spaces, or Three Spaces and Two Lines; and to of others. I have already shewn, how it is better that there should be but Seven different Letters, to name the Twelve Degrees of the Jemitonick Scale; but supposing there were Twelve Letters, it is plain we should need no more Lines to

to comprehend an Octave, because we might assign Two Letters to one Line or Space, as well as to make it, for Example, both c* and c, whereof the one belonging to the diatonick Series, should mark it for ordinary, and upon Occasions the other be brought in the same Way we now do the Signs * and |.

§ 2. A more particular Account of the Method; where, of the Nature and Use of Cless.

Tho' the Scale extends to Thirty Four diatonick Notes, which require Seventeen Lines with their Spaces, yet because no one single Piece of Melody comprehends near to many Notes, whatever several Pieces joyned in one Harmony comprehend among them; and because every Piece or single Song is directed or written distinctly by it self; therefore we never draw more than Five Lines, which comprehend the greatest Number of the Notes of any single Piece; and for those Cases which require more, we draw short Lines occasionally, above or below the 5, to serve the Notes that go higher or lower. See an Example in Plate 1. Fig. 8.

AGAIN, tho' every Line and Space may be marked at the Beginning with its Letter, as has been done in former Times; yet, fince the Art has been improven, only one Line is marked, by which all the rest are easily known, if we reckon up or down in the Order of the Letters;

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the Letter marked is called the Clef or Key, because by it we know the Names of all the other Lines and Spaces, and confequently the true Quantity of every Degree and Interval. But because every Note in the Octave is called a Key, tho' in another Sense, this Letter marked is called in a particular Manner the figued Clef, because being written on any Line, it not only figns or marks that one, but explains all the rest. And to prevent Ambiguity in what follows, by the Word Clef, I shall always mean that Letter, which, being marked on any Line, explains all the rest; and by the Word Key the principal Note of any Song, in which the Melody closes, in the Sense explained in the last Chapter. Of these signed Cless there are Three, viz. c, f, g; and that we may know the Improvement in having but one figned Clef in one particular Piece, also how and for what Purpose Three different Clefs are used in different Pieces, consider the following Definition.

A Song is either simple or compound. It is a simple Song, where only one Voice performs; or, tho' there be more, if they are all Unison or Octave, or any other Concord in every Note, 'tis still but the same Piece of Melody, performed by different Voices in the same or different Pitches of Tune, for the Intervals of the Notes are the same in them all. A compound Song is where Two or more Voices go together, with a Variety of Concords and Harmony; so that the Melody each of them makes, is a distinct and different simple Song, and all together.

ther make the compound. The Melody that each of them produces is therefore called a PART of the Composition; and all such Compositions are very properly called symphonetick Musick, or Musick in Parts; taking the Word Musick here for the Composition or Song it self.

Now, because in this Composition the Parts must be some of them higher and some lower, (which are generally so ordered that the same Part is always highest or lowest, tho' in modern Compositions they do frequently change,) and all written distinctly by themselves, as is very necessary for the Performance; therefore the Staff of Five Lines upon which each Part is written, is to be considered as a Part of the universal System or Scale, and is therefore called a particular System; and because there are but Five Lines ordinarily, we are to suppose as many above and below, as may be required for any single Part; which are actually drawn in the particular Places where they are necessary.

THE highest Part is called the TREBLE, or ALT whose Clef is g, set on the 2d Line of the particular System, counting upward: The lowest is called the BASS, i. e. Basis, because it is the Foundation of the Harmony, and formerly in their plain Compositions the Basis was first made, the 'tis otherwise now; the Basis-clef is f on the 4th Line upward: All the other Parts, whose particular Names you'll learn from Practice, I shall call MEAN PARTS, whose Clef is c, sometimes on one, sometimes on another Line; and some that are really mean Parts.

Parts are set with the g Clef. See Plate 1. Fig. 8. where you'll observe that the c and f Clefs are marked with Signs no way refembling these Letters; I think it were as well if we ufed the Letters themselves, but Custom has carried it otherwise; yet that it may not seem altogether a Whim, Kepler in Chap. Book 3d of his Harmony, has taken a critical Pains to prove, that these Signs are only Corruptions of the Letters they represent; the curious may confult him. Hall aw next bar

WE are next to consider the Relations of these Cless to one another, that we may know where each Part lies in the Scale or general System, and the natural Relation of the Parts among themselves, which is the true Design and Office of the Glefs. Now they are taken 5ths to one another, that is, the Cleff is lowest, c is a 5th, above it, and g a 5th above c. See them represented in Plate 1. Fig. 7. the last Column of the Scale; and observe, that the' in the particular Systems, the Treble or g Clef is ordinarily fet on the 2d Line, the Baff or f Clef on the 4th Line, and the mean or c Clef on the 3d Line (especially when there are but Three Parts.) yet they are to be found on other Lines; as particularly the mean Clef, which most frequently changes Place, because there are many mean Parts, is fometimes on the ift, the 2d, the 3d or 4th Line; but on whatever Line in the separate particular System any Clef is figned, it must be understood to belong to the same Place of the general System, and to be the fame

same individual Note or Sound on the Instrument which is directed by that Clef. as I have distinguish'd them in the Scale upon the Margin of the 3d Column; fo that to know what Part of the Scale any particular System is, we must take its Clef where it stands signed in the Scale (i.e. the last mentioned Fig.) and take as many Lines above and below it, as there are in the particular System; or thus, we must apply the particular System to the Scale, so as the Clef Lines coincide, and then we shall fee with what Lines of the Scale the other Lines of the particular System coincide : For Example, if we find the Clef on the 3d Line upward, in a particular System; to find the coincident Five Lines to which it refers in the Scale, we take with the f Clef Line, Two Lines above and Two below. Again, if we have the c Clef on the 4th Line, we are to take in the Scale with the Clef Line, One Line above and Three below, and so of others; so that according to the different Places of the Clef in a particular System, the Lines in the Scale correspondent to that Syftem may be all different, except the Clef Line which is invariable: And that you may with Ease find in the Scale the Five Lines coincident with every particular System, upon whatever Line of the Five the Clef may be fet, I have drawn Nine Lines across, which include each Five Lines of the Scale, in fuch a Manner, that you have the particular Systems distinguished for every relative Polition of any of the Three figned Clefs.

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As to the Reason of changing the relative Place of the Clef, i. e. its Place in the particular System, 'tis only to make this comprehend as many Notes of the Song as possible, and by that Means to have fewer Lines above or below it; fo if there are many Notes above the Clef. Note and few below it, this Purpose is answered by placing the Clef in the first or fecond Line; but if the Song goes more below the Clef, then it is best placed higher in the System: In short, according to the Relation of the other Notes to the Clef Note, the particular System is taken differently in the Scale, the Clef Line making one in all the Variety, which confifts only in this, viz. taking any Five Lines. immediately next other, whereof the Clef Line must always be one.

By this constant and invariable Relation of the Clefs, we learn easily how to compare the particular Systems of several Parts, and know how they communicate in the Scale, i. e. which Lines are unifon, and which are different, and how far, and confequently what Notes of the feveral Parts are unison, and what not: For you are not to suppose that each Part has a certain Bounds within which another must never come; no, some Notes of the Treble, for Example, may be lower than some of the mean Parts, or even of the Bass; and that not only when we compare fuch Notes as are not heard together, but even fuch as are. And if we would put together in one System, all the Parts of any Composition that are written separately. The Rule

is plainly this, viz. Place the Notes of each Part at the fame Distances above and below the proper Clef, as they stand in the separate System. And because all the Notes that are consonant (or heard together) ought to stand, in this Defign, perpendicularly over each other, therefore that the Notes belonging to each Part may be diffinctly known, they may be made with fuch Differences as shall not confuse or alter their Significations with respect to Time, and only fignify that they belong to fuch a Part; by this Means we shall fee how all the Parts change and pass thro' one another, i. e. which of them, in every Note, is highest or lowest or unison; for they do fometimes change, tho' more generally the Treble is highest and the Bass lowest, the Change happening more ordinarily betwixt the mean Part's among themselves, or these with the Treble or Bass The Treble and Bass Clefs are distant an Octave and Tone, and their Parts do feldom interfere, the Treble moving more above the Glef Note, and the Bass below: to setold tes

We see plainly then, that the Use of particular sign'd Clefs is an Improvement with respect to the Parts of any Composition; for unless some one Key in the particular Systems were distinguished from the rest, and referred invariably and constantly to one Place in the Scale, the Relations of the Parts could not be distinctly marked; and that more than one is necessary, is plain from the Distance there must be among the Parts: Or if one Letter is chosen for all.

all, there must be some other Sign to shew what Part it belongs to, and the Relation of the Parts. Experience having approven the Number and Relations of the signed Cless which are explained, I shall add no more as to that, but there are other Things to be here observed.

THE choosing these Letters f. c. g for signed Clefs, is a Thing altogether arbitrary; for any other Letter within the System, will explain the rest as well; yet 'tis fit there be a constant Rule, that the feveral Parts may be right distinguished; and concerning this observe again, that for the Performance of any fingle Piece the Clef ferves only for explaining the Invervals among the Lines and Spaces, fo that we need not mind what Part of any greater System it is, and we may take the first Note as high or low as we please: For as the proper Use of the Seale is not to limit the absolute Degree of Tone, so the proper Use of the figned Clef is not to limit the Pitch, at which the first Note of any Part is to be taken, but to determine the Tune of the rest with relation to the first, and, considering all the Parts together, to determine the Relations of their feveral Notes, by the Relations of their Clefs in the Scale : And so the Pitch of Tune being determined in a certain Note of one Part, the other Notes of that Part are determined, by the constant Relations of the Letters of the Scale; and also the Notes of the other Parts, by the Relations of their Clefs. To speak particularly of the Way of tuning the Infiruments that are employed in executing the ieveral feveral Parts, is out of my Way; I shall only fay this, that they are to be so tuned as the Clef Notes, wherever they ly on the Instruments which serve each Part, be in the foremention-

ed Relations to one another.

As the Harpsichord or Organ (or any other of the Kind) is the most extensive Instrument, we may be helped by it to form a clearer Idea of these Things: For consider, a Harpsichord contains in itself all the Parts of Musick, I mean the whole Scale or System of the modern Practice; the foremost Range of Keys contains the diatonick Series beginning, in the largest Kind, in g, and extending to c above the Fourth 8ve; which therefore we may well suppose represented by the preceeding Scale. In Practice, upon that Instrument, the Clef Notes are taken in the Places represented in the Scheme; and other Instruments are fo tuned, that, considering the Parts they perform, all their Notes of the fame Name are unison to those of the Harpsichord that belong to the same Part. I have said, the Harpsiebord contains all the Parts of Musick; and indeed any Two distinct Parts may be performed upon it at the same Time and no more; yet upon Two or more Harpfichords tuned unifons, whereby they are in Effect but one, any Number of Parts may be executed: And in this Cafe we should see the several Parts taken in their proper Places of the Instrument, according to the Relations of their Clefs explained: And as to the tuning the Instrument, Ishall only add, that there is a certain Pitch to which

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it is brought, that it may be neither too high nor too low, for the Accompaniment of other Instruments, and especially for the human Voice, whether in Unison or taking a different Part; and this is called the Consort Pitch. have done, you must consider, that for performing any one fingle Part, we may take the Clef Note in any 80e, i. e. at any Note of the fame Name, providing we go not too high or too low for finding the rest of the Notes of the Songt But in a Confort of several Parts, all the Clefs must be taken, not only in the Relations, but also in the Places of the System already mentioned, that every Part may be comprehended in it: Yet still you are to mind, That the Tune of the Whole, or the absolute Pitch, is in it self an arbitrary Thing, quite foreign to the Use of the Scale; tho' there is a certain Pitch generally agreed upon, that differs not very much in the Practice of any one Nation or Set of Musicians from another. And therefore,

WHEN I speak of the Place of the Clefs in the Scale or general System, you must understand it with respect to a Scale of a certain determined Extent; for this being undetermined, so must the Places of the Clefs be: And for any Scale of a certain Extent, the Rule is, that the mean Clefc be taken as near the Middle of the Scale as possible, and then the Clefg a 5th above, and f a 5th below, as it is in the present general System of Four sees and a 6th, represented in the preceding Scheme, and actually

determined upon Harpsichords.

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In the last Place consider, that since the Lines and Spaces of the Scale, with the Degrees stated among them by the Letters, fufficiently determine how far any Note is distant from another, therefore there is no Need of different Characters of Letters, as would be if the Scale were only exprest by these Letters: And when we speak of any Note of the Scale, naming it by a or b, &c. we may explain what Part of the Scale it is in, either by numbring the 8ves from the lowest Note, and calling the Note spoken of (for Example) c in the lowest 8ve or in the 2d 8ve, and so on: Or, we may determine its Place by a Reference to the Seat of any of the Three figned Clefs; and so we may say of any Note, as f or g, that it is such a Clef Note, or the first or second, &c. f or g above such a Clef. Take this Application, suppose you ask me what is the highest Note of my Voice, if I fay d, you are not the wifer by this Answer, till I determine it by faying it is d in the fourth Octave, or the first d above the Treble Clef. But again, neither this Question nor the Answer is fufficiently determined, unless it have a Reference to some supposed Pitch of Tune in a certain fixt Instrument, as the ordinary Consort Pitch of a Harpsichord, because, as I have frequently faid, the Scale of Musick is concerned only with the Relation of Notes and the Order of Degrees, which are still the same in all Dif-ferences of Tune, in the whole Series.

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13. Of the Reason, Use, and Variety of the Signatures of CLEFS. all to a mary a regard

T Have already faid, that the natural and artificial Note expressed by the same Letter, as c and com, are both fet on the same Line or Space. When there is no * or / marked on any Line or Space, at the Beginning with the Clef, then all the Notes are natural; and if in any particular Place of the Song, the artificial Note is required, 'tis signified by the Sign * or 1, fet upon the Line a Space before that Note; but if a * or V is fet at the Beginning in any Line or Space with the Clef, then all the Notes on that Line or Space are the artificial ones, that is, are to be taken a Semitone higher or lower than they would be without fuch a Sign; the fame affects all their 8ves above or below, tho' they are not marked fo. And in the Course of the Song, if the natural Note is fometimes required, it is fignified by this Mark 4. And the marking the System at the Beginning with Sharps or Flats, I call the Signature of the Clef. हिंदी विकासिक का 30 के अंग अ वर अंगले व

In what's faid, you have the plain Rule for Application; but that we may better conceive the Reason and Use of these Signatures, it will be necessary to recollect, and also make a little clearer, what has been explained of the Nature of Keys or Modes, and of the Original and Ufe of the sharp and flat Notes in the Scale. I have

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in Chap. 9. explained what a Key and Mode in Mulick is; I have distinguished betwixt these Two, and shewn that there are and can be but Two different Modes, the greater and the leffer, according to the Two concinnous Divisions of the 8ve, viz. by the 3d g. or the 3d l. and their proper Accompanyments; and whatever Difference you may make in the absolute Pitch of the whole Notes, or of the first Note which limites all the reft, the fame individual Song must still be in the same Mode; and by the Key I understand only that Pitch or Degree of Tune at which the fundamental or close Note of the Melody. and confequently the whole 8ve is taken; and because the Fundamental is the principal Note of the 8ve which regulates the rest, it is peculiarly called the Key. Now as to the Variety of Keys, if we take the Thing in fo large a Sense as to fignify the absolute Pitch of Time at which any fundamental Note may be taken, the Number is at least indefinite, but in Practice it is limited, and particularly with respect to the Denominations of Keys, which are only Twelve, viz. the Twelve different Names or Letters of the femitonick Scale; so we say the Key of a Song is c or d, &c. which fignifies that the Cadence or Close of the Melody is upon the Note of that Name when we speak of any Instrument; and with respect to the human Voice, that the close Note is Unifon to fuch a Note on an Instrument; and generally, with respect both to Instruments and Voice, the Denomination of the Key is taken from the Place of the close

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close Note upon the written Musick, i. e. the Name of the Line or Space where it stands: Hence we fee, that tho' the Difference of Keys refers to the Degree of Tune, at which the Fundamental, and confequently the whole 8ve is taken, in Distinction from the Mode or Constitution of an Octave, yet these Denominations determine the Differences only relative y, with respect to one certain Series of fixt Sounds, as a Scale of Notes upon a particular Instrument, in which all the Notes of different Names are different Keys, according to the general Definition, because of their different Degrees of Tune; but as the tuning of the whole may be in a different Pitch, and the Notes taken in the same Part of the Instrument, are, without respect to the tuning of the Whole, still called by the same Names c or d, &c. because they serve only to mark the Relation of Tune betwixt the Notes, therefore 'tis plain, that in Practice a Song will be faid to be in the same Key as to the Denomination, tho' the absolute Tune be different, and to be in different Keys when the absolute Tune is the fame; as if the Note a is made the Key in one Tuning, and in another the Note d unifon to a of the former. Now, this is a Kind of Limitation of the general Definition, yet it ferves the Design best for Practice, and indeed cannot be otherwise without infinite Confusion. I shall a little below make fome more particular Remarks upon the Denominations of Sounds or Notes raised from Instruments or the human Voice: But from what has been explained, you'll eafily Y 4

eafily understand what Difference I put betwixt a Mode and a Key; of Modes there are only Two, and they respect what I would call the Internal Constitution of the 8ve, but Keys are indefinite in the more general and abstract Sense, and with regard to their Denominations in Practice they are reduced to Twelve, and have respect to a Circumstance that's external and accidental to the Mode; and therefore a Key may be changed under the same Mode, as when the fame Song, which is always in the fame Mode, is taken up at different Notes or Degrees of Tune, and from the same Fundamental or Key a Series may proceed in a different Mode, as when different Songs begin in the same Note. But then because common Use applies the Word Key in both Senses, i. s. both to what I call a Key and a Mode, to prevent Ambiguity the Word Sharp or flat ought to be added when we would express the Mode; so that a sharp Key is the same as a greater Mode, and a flat Key a lesser Mode; and when we would express both Mode and Key, we joyn the Name of the Key Note, thus, we may fay fuch a Song is for Example in the Sharp or flat Key c, to signific that the fundamental Note in which the Close is made is the Note called c on the Instrument, or unifon to it in the Voice; or generally, that it is fet on the Line or Space of that Name in Writing; and that the 3d g. or 3d l. is used in the Melody, while the Song keeps within that Key; for I have also observed, that the same Song may be carried thro' different Keys, or make

make successive Cadences in different Notes, which is commonly ordered by bringing in some Note that is none of the natural Notes of the former Key, of which more immediately: But when we hear of any Key denominated c or d without the Word Sharp or flat, then we can understand nothing but what I have called the Key in Distinction from the Mode, i. e. that the

Cadence is made in fuch a Note.

AGAIN, I have in Chap. 10. explained the Use of the Notes we call sharp and flat, or artificial Notes, and the Distinction of Keys in that respect into natural and artificial; I have shewn that they are necessary for correcting the Defects of Instruments having fixt Sounds, that beginning at any Note we may have a true concinnous diatonick Series from that Note, which in a Scale of fixt Degrees in the 8ve we cannot have, all the Orders of Degrees proceeding from each of the Seven natural Notes being different, of which only Two are concinnous, viz. from c which makes a sharp Key, and from a which makes a flat Key; and to apply this more particularly, you must understand the Use of these sharp or flat Notes to be this, that a Song, which, being set in a natural Key or without Sharps and Flats, is either too high or too low, may be transposed or set in another more convenient Key; which necessarily brings in some of the artificial Notes, in order to make a diatonick Series from this new Key, like that from the other; and when the Song changes the Key before it come to the final

final Close, tho' the principal Key be natural, yet some of these into which it changes may require artificial Notes, which are the essential and natural Notes of this new Key; for tho' this be called an artificial Key, 'its only so with respect to the Names of the Notes in the fixt System, which are still natural with respect to their proper Fundamental, viz. the Key into which the Piece is transposed, or into which it changes where the principal Key is natural.

AND even with respect to the human Voice, which is under no Limitation, I have shewn the Necessity of these Names, for the sake of a regular, distinct and easy Representation of Sounds, for directing the Voice in Performance. I shall next more particularly explain by fome Examples, the Business of keeping in and going out of Keys. Example. Suppose a Song begins in c, or at least makes the first Close in it; if all the Notes preceeding that Close are in true musical Relation to c as a Fundamental in one Species, suppole as a sharp Key, i. e. with a 3d g. the Melody has been still in that Key (See Example 5. Plate 3.) But if proceeding, the Composer brings in the Note f he leads the Melody out of the former Key, because f is none of the natural Notes of the 8ve c, being a falle 4th to c. gain, he may lead it out of the Key without any false Note, by bringing in one that belongs not to the Species in which the Melody was begun: Suppose after beginning in the Sharp Key c, he introduces the Note gw, which is a 6th 1. tor, and therefore harmonious, yet it belongs

longs to it as a flat Key, and confequently is out of the Key as a sharp one: And because the fame Song cannot with any good Effect be made to close twice in the same Note in a different Species, therefore after introducing the Note gm, the next Close must be in some other Note as a, and then the Key in both Senses will be changed, because a has naturally a 3d1; and therefore when any Note is faid to be out of a Key, 'tis understood to be out of it either as making a false Interval, or as belonging to it in another Species than a supposed one, i. e. if it belong to it as a sharp Key, tis out of it as a flat one; so in Example 3. Plate 3. the first Close is in a as a sharp Key, all the preceeding Notes being natural to it as fuch; then proceeding in the fame Key, you see g (natural) introduced, which belongs not to a as a Sharp Key, and alio ax, which is quite out of the former Key: By these Notes a Close is brought on in b, and the Melody is faid to be out of the first Key, and is so in both Senses of the Word Key, for b here has a 3dl; then the Melody is carried on to a Close in d, which is a Third Key, and with respect to that Piece is indeed the principal Key, in which also the Piece begins; but I shall consider this again; it was enough to my Purpose here, that all the Notes from the Beginning to the first Close in a were natural to the Octave from a with a 3d g; and tho' the 3dg. above the Close is not used in the Example, yet the 6th l. below it is used, which is the fame Thing in determining the Species.

I have explained already, that with the 3dl. the 6th l. and 7th l, or 6th g. and 7th g. are used in different Circumstances; and therefore you are to mind that the 6th g.or 7th g. being introduced upon a flat Key, does not make any Change of it; so that tho' the 6thl. and 7thl. is a certain Sign of a flat Key, yet the 6th g. and 7th g. belong to either Species; therefore the Species is only certainly determined by the ad in both Cases; and so in the preceeding Example, where I suppose gx is introduced upon the sharp Key c, the next Close cannot be in c, because gx being a 6th l, to c, requires a 3d. 1. which would altogether destroy that Unity of Melody which ought to be kept up in every Song; therefore when I fay the same Song cannot close twice in one Note in different Species, the Determination of that Difference depends on the 3d, which being the greater, must always have the 6th g. and 7th g. but the 3d l. takes fometimes the 6thl. and 7thl. fometime the 6thg. and 7th g. See Ex. 6. Plate 3. where the whole keeps within the flat Key a, and closes twice in it; the first Close is brought on with the 6th l. and 7th l. the next Close in the Octave above is made with the 6thg. and 8thg. but a Close in a, ufing the 3dg. would quite ruine the Unity of the Melody; yet the same Song may be carried into different Keys, of which some are sharp, some flat, without any Prejudice; but of all these there must be one principal Key, in which the Song fets out, and makes most frequent Cadences, and at least the final Cadence: THE

The last Thing I shall observe upon this Subject of Keys is, that sometimes the Key is changed, without bringing the Melody to a Cadence in the Key to which it is transferred, that is, a Note is introduced, which belongs properly to another Key than that in which the Melody existed before, yet no Cadence made in that Key; as if after a Cadence in the sharp Key c, the Note g* is brought in, which should naturally lead to a Close in a, yet the Melody may be turned off without any formal and perfect Close in a, and brought to its next

Close in another Key.

I return now to explain the Reason and Use of the Signatures of Clefs. And first, Let us suppose any Piece of Melody confined strictly to one Mode or Key, and let that be the natural sharp Key c, from which as the Relation of the Letters are determined in the Scale, there is a true mufical Series and Gradation of Notes, and therefore it requires no * or 1, confequently the Signature of the Clef must be plain: But let the Piece be transposed to the Key d, it must necessarily take fix instead of f, and cx for c, because f is the true 3dg. and c the true 7th g. to d. See an Example in Plate 3. Fig. 5. Now if the Clef be not figned with a * on the Seat of f and c, we must supply it wherever thele Notes occur thro' the Piece, but 'tis plainly better that they be marked once for all at the Beginning.

AGAIN, suppose a Piece of Melody, in which there is a Change of the Key or Mode; if the same

fame Signature answer all these Keys, there is no more Question about it; but if that cannot be, then the Signature ought to be adjusted to the principal Key, rather than to lany other, as in Example 3. Plate 3. in which the principal Key is d with a 3dg. and because this demands f * and c * for its 3d and 7th, therefore the Signature expresseth them. The Piece actually begins in the principal Key, tho' the first Close is made in the 5th above, viz. in a, by bringing in gw; which is very naturally managed, because all the Notes from the Beginning to that Close belong to both the sharp Keys d and a, except that g* which is the only Note in which they can differ; then you fee the Melody proceeds for some time in Notes that are common to both these Keys, tho' indeed the Impression of the last Cadence will be strongest; and then by bringing g (natural) and ax, it leaves both the former Keys to close in b; and here again there is as great a Coincidence with the principal Key as possible, for the flat Key b has every one of its effential Notes common with some one of these of the Sbarp Key d, except ax and gx the 6thg. and 7th g. which that flat Key may occasionally make use of; but as it is managed here, the 6th l. is used, so that it differs from the principal Key only in one Note ax; then the Melody is after this Close immediately transferred to the principal Key, making there the final Cadence. In what Notes every Key differs from or coincides with any other, you may learn from the Scale of Semitones: but

but you shall see this more easily in a following Table.

To proceed with our Signatures, you have, in what's faid, the true Use and Reason of the Signatures of Clefs; in respect of which they are distinguished into natural, and artificial or transposed Clefs; the first is when no * or ' is set at the Beginning; and when there are, it is said to be transposed. We shall next consider the Variety of Signatures of Clefs, which in all are but 12. and the most reasonable Way of making the artificial Notes, either in the general Signature, or where they occur upon the Change of the Key.

In the femitonick Scale there are 12 different Notes in an Octave (for the 13th is the same with the ift) each of which may be made the Fundamental or Key of a Song, i. e. from each of them we can take a Series of Notes, that shall proceed concinnously by Seven diatonick Degrees of Tones and Semitones to an Octave, in the Species either of a sharp or flat Key, or of a greater or lesser Mode (the small Errors of this Scale as it is fixt upon Instruments, being in all this Matter neglected.) Now, making each of these 12 Letters or Notes a Fundamental or Key-note, there must be in the Compass of an Oftave from each, more or fewer, or different Sharps and Flats necessarily taken in to make a concinnous Series of the same Species, i.e. proceeding by the greater or leffer 3d (for thefe specify the Mode, and determine the other Differences, as has been explained); and fince from every one of the 12 Keys we may proceed concinnous-

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cinnoully, either with a greater or lesser 3d, and their Accompanyments, it appears at first Sight, that there must be 24 different Signatures of Clefs, but you'll eafily understand that there are but 12. For the same Signature serves Two different Keys, whereof the one is a sharp and the other a flat Key, as you fee plainly in the Nature of the diatonick Scale, in which the 0-Etave from c proceeds concinnously by a 3dg. and that from a (which is a 6th g. above, or a 3dl. below c) by a 3dl. with the 6th l. and 7th 1. for its Accompanyments, which I suppose here essential to all flat Keys; consequently, if we begin at any other Letter, and by the Use of * or I make a concinnous diatonick Series of either Kind, we shall have in the same Series, continued from the 6th above or 3d below, an Octave of the other Species; therefore there can be but 12 different Signatures of Clefs, whereof 1 is plain or natural, and 11 transposed or artificial.

What the proper Notes of these transposed Cless are, you may find thus; let the Scale of Semitones be continued to Two Octaves, then begin at every Letter, and, reckoning Two Semitones to every Tone, take Two Tones and one Semitone, then Three Tones and one Semitone, which is the Order of a sharp Key or of the natural Octave from c, the Letters which terminate these Tones and Semitones, are the essential or natural Notes of the Key or Octave, whose Fundamental is the Letter or Note you begin at: By this you'll find the Notes be onging to every sharp Key; and these being continued,

nued, you'll have also the Notes belonging to every flat Key, by taking the 6th above the (harp Key for the Fundamental of the flat: But to fave you the Trouble, I have collected them in one Table. See Plate 2. Fig. 1. The Table has Two Parts, and the upper Part contains 16 Columns: From the 3 to the 14 inclusive, you have exprest in each an Octave, proceeding from some the 12 Notes of different Names within the semitonick Scale, the Fundamental whereof you take in the lower End of the Column, and reading it upward, you have all the Letters or Names belonging to that Offave in a diatonick Scale, in the Species of a sharp Key: In the of Column on the left Hand you have the Degrees marked in Tones and Semitones, without any Distinction of greater and lesser Tone: In the Fifth Column, you have the Denominations of the Intervals from the Fundamental. Then for the 12 flat Keys take, as I faid before, the 6ths above the other, and they are the Fundamentals of the flat Keys, whose Notes are all found by continuing the Scale upward: But as to finding the Note where any Interval ends, 'tis as well done by counting downward; for fince 'tis always an Octave from any Letter to the same again, and also since a 7th upward falls in the same Letter with a 2d downward, a 6th upward in the same with a 3d downward, and a 3d upward in the same with a 6th downward, also a 4th or 5th upward in the same with a 5th or 4th downward; therefore in the 16th Column, you fee Key flat written written against the Line in which the 6ths of the 12 Sharp Keys stand; and the Denomination of the Intervals are written against these Notes where they terminate; and because the Scale in that Table is carried but to one Octave, so that we have only a 3d 1. above the Fundamental of the flat Key, therefore the rest of the Intervals are marked at the Letters below, which will be easier understood if you'll suppose the Key to stand below, and these Intervals to be reckoned upwards. In the 2d Part of the Table you have a System of 5 Lines marked with the Treble or g Clef, in 13 Divisions each answering to a Column of the upper Part; and these express all the various Signatures of the Clef, that is, all the accidental or sharp and flat Notes that belong to any of the 12 Keys of the Scale: of of but to some of no-

- WITH Respect to the Names and Signatures in the Table, there remain fome Things to be explained: I told you in the last Chapter that upon the main it was an indifferent Thing whether the artificial Notes in the Scale were named from the Note below with a x, or from that above with a let Here you have each of them marked, in some Signatures & and in others /; but in every particular Signature the Marks are all of one Kind * or /, tho' one Signature is *, and another b; and these are not so ordered at random; the Reafon I shall explain to you: In the first Place there is a greater Harmony with respect to the Eye; but this is a fmall Matter, a better Reason follows; consider

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der, every Letter has two Powers, i. e. is capable of reprefenting Two Notes, according as you take it natural or plain, as c, d, &c. or transposed as c* or d; again, every Line and Space is the Seat of one particular Letter: Now if we take Two Powers of one Letter in the same Octave or Key, the Line or Space to which it belongs must have Two different Signs; and then when a Note is fet upon that Line or Space, how shall it be known whether it is to be taken natural or transposed? This can only be done by fetting the proper Signs at every fuch Note; which is not only troublesom, but renders the general Signature useless as to that Line or Space: This is the Reason why some Signatures are made * rather than 1, and contrarily; for Example, take for the Fundamental cx, the rest of the Notes to make a sharp Key are d* .f : f* : g* : a* : c. where you fee f and c are taken both natural and transposed. which we avoid by making all the artificial Note b, as in the Table, thus av : ev . f : gv : av : V: c. dv. Tis true that this might be helped another Way, viz. by taking all the Notes * i. e. taking ex for f, and bx for c; but the Inconveniency of this is visible, for hereby we force Two natural Notes out of their Places, whereby the Difficulty of performing by fuch Direction is increased: In the other Cases where I have marked all & rather than *, the fame Reasons obtain: And in some Cases, some Ways of figning with * would have both thefe Inconveniencies. The same Reasons make it Z necessary hecessary to have some Signature * rather than b; but the Octave beginning in gb is singular in this Respect, that it is equal which Way it is signed, for in both there will be one natural Note displaced unavoidably; as I have it in the Table b natural is signed cb, and if you make all the Signs *, you must either take in Two Powers of one Letter, or take e* for f. Now neither in this, nor any of the other Cases will the mixing of the Signs remove the Inconveniencies; and suppose it could, another follows upon the Mixture, which leads me to shew why the same Clef is either all * or all b, the Reason follows.

THE Quantity of an Interval exprest by Notes fet upon Lines and Spaces marked fome *, fome b, will not be fo easily discovered, as when they are all marked one Way, because the Number of intermediate Degrees from Line to Space, and from Space to Line, answers not to the Denomination of the Interval; for Example, if it is a 5th, I shall more readily difcover it when there are 5 intermediate Degrees from Line to Space, than if there were but 4; thus, from g* to d* is a 5th, and will appear as fuch by the Degrees, among the Lines and Spaces; but if we mark it gx, ev, it will have the Appearance of a 4th; also from fx to ax is a 3d, and appears fo, whereas from fx to V looks like a 4th; and for that Reason Mr. Simpson in his Compend of Musick calls it a leffer 4th, which I think he had better called an apparent 4th; and so by making the Signs of the Glef,

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Clef all of one Kind, this Inconveniency is faved with respect to all Intervals whose both Extremes have a transposed Letter; and as to fuch Intervals which have one Extreme a natural Note, or exprest by a plain Letter, and the other transposed, the Inconveniency is prevented by the Choice of the * in some Keys. and of the 1 in others; for Example, from d to fix is a 3dg. equal to that from d to gl, but the first only appears like a 3d, and so of other Intervals from d, which therefore you fee in the Table are all figned *. Again from f to 1 or f to ax is e. 4th, but the first is the best Way of marking it; there are no more transposed Notes in that Octave, nor any other Octave, whose Fundamental is a natural Note, that is marked with /.

It must be owned, after all, That whatever Way we chuse the Signs of transposed Notes, the Sounds or Notes themselves on an Instrument are individually the same; and marking them one Way rather than another, respects only the Conveniencies of representing them to the Eye, which ought not to be neglected; especially for the Direction of the human Voice, because that having no fixt Sounds (as an Instrument has, whose Notes may be found by a local Memory of their Seat on the Instrument) we have not another Way of finding the true Note but computing the Interval by the intermediate diatonick Degrees, and the more readily this can be done, it is certainly the

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Now you are to observe, that, as the Signature of the Clef is defigned for, and can ferve but one Key, which ought rather to be the principal Key or Octave of the Piece than any other, shewing what transposed Notes belong to it, fo the Inconveniency last mentioned is remedied, by having the Signs all of one Kind, only for these Intervals one of whose Extremes is the Key-note, or Letter: But a Song may modulate or change from the principal into other Keys, which may require other Notes than the Signature of the Clef affords; fo we find * and 1 upon some particular Notes contrary to the Clef, which shews that the Melody is out of the principal Key, such Notes being natural to some other subprincipal Key into which it is carried; and these Signs are, or ought always to be chosen in the most convenient Manner for expressing the Interval; for Example, the principal Key being C with a 3d g. which is a natural Octave (i. e. expressed all with plain Letters) suppose a Change into its 4th f; and here let a 4th upward be required, we must take it in / or ax; the first is the best Way, but either of them contradicts the Clef which is natural; and we no fooner find this than we judge the Key is changed. But again, a Change may be where this Sign of it cannot appear, viz. when we modulate into the 6th of a swarp principal Key, or into the 3d of a flat principal Keys; because these have the same Signature, as has been already shown, and have

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fuch a Connection that, unless by a Cadence, the Melody can never be faid to be out of the principal Key. And with respect to a flat principal Key, observe, That if the 6th g. and 7th g. are used, as in some Circumstances they may, especially towards a Cadence, then there will be necessarily required upon that 6th and 7th, another Sign than that with which its Seat is marked in the general Signature of the Clef. which marks all flat Keys with the lesser 6ths and 7ths; and therefore in fuch Cafe (i. e. where the principal Key is flat) this Difference from the Clef is not a Sign that the Melody leaves the Key, because each of these belong to it in different Circumstances; yet they cannot be both marked in the Clef, therefore that which is of more general Use is put there and the other marked occasionally.

FROM what has been explained, you learn another very remarkable Thing, viz. to know what the principal Key of any Piece is, without feeing one Note of it; and this is done by knowing the Signature of the Clef: There are but Two Kinds of Keys (or Modes of Melody) diftinguished into sharp and flat, as already explained; each of which may have any of the 12 different Notes or Letters of the semitonick Scale for its Fundamental; in the 1st and 6th Line of the upper Part of the preceeding Table you have all these Fundamentals or Key-notes, and under them respectively stand the Signatures proper to each, in which, as has been the

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often faid, the flat Keys have their 6th and 7th marked of the leffer Kind; and therefore as by the Key, or fundamental Note, we know the Signature, fo reciprocally by the Signature we can know the Key; but 'tis under this one Limitation that, because one Signature serves Two Keys, a sharp one, and a flat, which is the 6th above or 3d below the sbarp one, therefore we only learn by this, that it is one of them, but not which; for Example, if the Clef has no transposed Note but fx, then the Key is g with a 3d g. or e with a 3d l. If the Clef has 1 and eV, the Key is I with a 3d g. or g. with a 3d 1. as so of others, as in the Table: I know indeed, for I have found it fo in the Writing of the best Masters, that they are not strict and constant in observing this Rule concerning the Signature of the Cef, especially when the principal Key is a flat one; in which Case you'll find frequently, that when the 6th l. or 7th l. to the Key, or both, are transposed Notes, they don't fign them so in the Clef, but leave them to be marked as the Course of the Melody requires; which is convenient enough when the Piece is so conducted as to use the lesser 6th and 7th feldomer than the greater.

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§ 4. Of Transposition.

THERE are Two Kinds of Transposition, the one is, the changing the Places or Seats of the Notes or Letters among the Lines and Spaces, but so as every Note be set at the same Letter; which is done by a Change with respect to the Clef: The other is the changing of the Key, or setting all the Notes of the Song at different Letters, and performing it consequently in different Notes upon an Instrument: Of these in Order.

1. Of Transposition with respect to the Clef.

This is done either by removing the same Clef to another Line; or by using another Clef; but still with the same Signature, because the Piece is still in the same Key: How to set the Notes in either Case is very easy: For the 1st, You take the first Note at the same Distance above or below the Clef-note in its new Position, as it was in the former Position, and then all the rest of the Notes in the same Relations or Distances one from another; so that the Notes are all set on Lines and Spaces of the same Name. For the 2d, or setting the Musick with

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with a different Clef, you must mind that the Places of the Three Clef-notes are invariable in the Scale, and are to one another in these Relations, viz. the Mean a 5th above the Bass; and the Treble a 5th above the Mean, and confequently Two 5ths above the Bass: Now when we would transpose to a new Clef, suppose from the Treble to the Mean, whereveer we fet that new Clef, we suppose it to be the same individual Note, in the same Place of the Scale, as if the Piece were that Part in a Composition to which this new Clef is generally appropriated, that fo it may direct us to the same individual Notes we had before Transposition: Now from the fixt Relations of the Three Clefs in the Scale, it will be easy to find the Seat of the first transposed Note, and then all the rest are to be set at the same 'mutual Distances they were at before; for Example, fuppose the first Note of a Song is d, a 6th above the Bass-clef, the Piece being set with that Clef, if it is transposed and set with the Mean-clef, then wherever that Clef is placed, the first Note must be the 2d g. above it, because a 2d g. above the Mean is a 6th g. above the Bass-clef, the Relation of these Two being a 5th; and fo that first Note will still be the same individual d: Again, let a Piece be fet with the Treble-clef, and the first Note be e, a 3d 1. below the Clef, if we transpose this to the Mean-clef, the first Note must be a 3d g. above it, which is the same individual Note e in that Scale, for a 3d l. and 3d g. make

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make a 5th the Distance of the treble and mean Clefs.

THE Use and Design of this Transposition is, That if a Song being fet with a certain Clef in a certain Polition, the Notes shall go far above or below the System of Five Lines, they may, by the Change of the Place of the fame Clef in the particular System, or taking a new Clef, be brought more within the Compass of the Five Lines: That this may be effected by fuch a Change is very plain; for Example, Let any Piece be fet with the Treble Clef on the first Line, (counting upward) if the Notes lie much below the Clef Note, they are without the System, and 'tis plain they will be reduced more within it, by placing the Clef on any other Line above; and fo in general the fetting any Clef lower in a particular System reduces the Notes that run much above it; and fetting it higher reduces the Notes that run far below. The fame is effected by changing the Clef it felf in some Cases, tho' not in all, Thus, if the Treble Part, or a Piece fet with the Treble Clef, runs high above the System, it can only be reduced by changing the Place of the same Clef; but if it run without the System below, it can be reduced by changing to the Mean or Bass Clef. It the mean Part run above its particular System, it will be reduced by changing to the Treble Clef; or if it run below, by changing to the Bass Clef. Lastly. If the Bass Part run without its System below, it can only be reduced by changing the Place of the same Clef, but running above above, it may be changed into the mean or treble Clef. Now as to the Position of the new Clef, you must choose it so that the Design be best answered; and in every Change of the Clef the Notes will be on Lines and Spaces of the same Name, or denominated by the same Letter, they refer also to the same individual Place of the Scale or general System, differing only with respect to their Places in the particular System which depend on the Difference of the Clet's and their Positions, and therefore will always be the same individual Notes upon the same Instrument.

As to both these Transpositions I must obferve, that they increase the Difficulty of Practice, because the Relations of the Lines and Spaces change under all these Transpositions, and therefore one must be equally familiar with all the Three Clefs, and every Polition of them, fo that under any Change we may be able with the same Readiness to find the Notes in their true Relations and Distances: And as this is not acquired without great Application, I think it is too cruel a Remedy for the Inconveniency to which it is applied: It is better, I should think, to keep always the same Clef for the same Part, and the same Position of the Clef; but If one will be Master of several Instruments, and be able to perform any Part, then he must be equally well acquainted with all their proper Clefs, but still the Position of the Clef in the particular System may be fixt and invariable.

2. Of Transposition from one Key to another.

THE Design of this Transposition is, That a Song, which being begun in one Note is too high or low, or any other way inconvenient, as may be in some Cases for certain Instruments, may be begun in another Note, and from that carried on in all its just Degrees and Intervals. The Clef and its Polition are the same, and the Change now is of the Notes themselves from one Letter and its Line or Space to another. In the former Transposition the Notes were expresfed by the same Letters, but both removed to different Lines and Spaces; here the Letters are unmoved, and the Notes of the Song are transferred to or expressed by other Letters, and confequently fet also upon different Lines and Spaces, which it is plain will require a different Signature of the Clef. Now we are eafily directed in this Kind of Transposition, by the preceeding Table, Plate 2. Fig. 1. For there we see the Signature and Progress of Notes in either sharp or flat Keys beginning at every Letter: The lower Line of the upper Part of the Table contains the fundamental Notes of the Twelve Sharp Keys; and under them are their Signatures, shewing what artificial Notes are necessary to make a concinnous diatonick Series from these several Fundamentals: In the 6th Line above are the fame Twelve Letters, considered as Fundamentals of the Twelve flat Keys, which have the same Signatures with

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the sharp Keys standing in the under Line, and in the fame Column: So that 'tis equal to make any of these Twelve Notes the Key Note, changing the Signature according to the Table: And observe, tho' the Fundamentals of the Twelve flat Keys stand in the Table as 6ths to the Twelve sharp Keys, yet that is not to be understood as if the flat Keys must all be a 6th above (or in their 8ves a 3d below) the sharp Keys; it happens so there only in the Order and Relation of the Degrees of the Scale: But as the Fundamentals of the Twelve flat Keys are the same Letters with those of the sharp Keys, they shew us that the same Key may either be the sharp or flat, with a different Signature.

Bur to make this Matter as plain as possible, I shall consider the Application of it in Two distinct Questions. 1 mo. Let the Fundamental or Key Note to which you would transpose a Song be given, to find the proper Signature. Rule. In the first or 6th Line of the upper Part, according as the Key is Sharp or flat, find the given Key to which you would transpose, and under it you have the proper Signature. For Example, Suppose a Song in the Sharp Key c, which is natural, if you would transpose it to g, the Clef must be signed with fx, or to d and it must have f* and c*. Again, suppose a Song in a flat Key as d whose Signature has b flat, if you transpose it to e the Signature has f*, or to g and it has & and ev. 2do. Let any Signature be affigned to find the Key to which we must tranftranspose. Rule. In the upper Part of the Table in

the fame Column with the given Signature you'll

find the Key fought, either in the 1st or 6th Line according as the Key is sharp or flat. But without considering the Key, or whether the Signature be regular or not, we may know

how to transpose by considering the Signature as it is and the first Note, thus, find the Signature with which it is already fet, and in the fame Column in the upper Part find the Letter of the first Note; in that same Line (betwixt Right and Left) find the Letter where you defire to begin, and under it is the proper Signature to be now used: Or having chosen a certain Signature you'll find the Note to begin at, in the same Column, and in the same Line with the Note it began in formerly. Having thus your Signature, and the Seat of the first Note, the rest are easily set up and down at the same

mutual Distances they were in formerly; and

where any *, b or 4 is occasionally upon any

Note, mark it to in the correspondent Note in

the Transposition; but mind that if a Note with

a * or 1 is transposed to a Letter which in the

new Signature is contrarily v or *, then mark

that Note 4; and reciprocally if a Note marked

4 is transposed to a Letter, which is natural in

the new Signature, mark it * or \ according

as the 4 was the removing of a v or * in the

former Signature. In all other Cases mark the

transposed Note the same Way it was before.

For Examples of this Kind of Transposition, see

Plate 3. Examples 3 and 5.

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§ 5. Of Sol-fa-ing, with some other particular Remarks about the Names of Notes.

IN the fecond Column of the preceeding Table, you have these Syllables written a-gainst the several Letters of the Scale, viz. fa, sol, la, fa, sol, la, mi, fa, &c. Formerly these Six were in use, viz. ut, re, mi, fa, fol, la; from the Application whereof the Notes of the Scale were called G fol re ut, A la mi re, &c. and afterwards a 6th was added, viz. si; but these Four fa, sol, la, mi being only in Use a mong us at present, I shall explain their Use here, and speak of the rest, which are still in Use with some Nations, in Chap. 14. where you shall learn their Original. As to their Use, it is this in general; they relate chiefly to Singing or the human Voice, that by applying them to every Note of the Scale it might not only be pronounced more eafily, but principally that by them the Tones and Semitones of the natural Scale may be better marked out and distinguifhed.

This Design is obtain'd by the Four Syllables fa, sol, la, mi, in this Manner; from fa to sol is a Tone, also from sol to la, and from la to mi, without distinguishing the greater and lesser Tone;

Tone; but from la to fa, also from mi to fa is a Semitone: Now if these are applied in this Order, fa, fol, la, fa, fol, la, mi, fa, &c. they express the natural Series from c, as in the Table; and if it is repeated to another 800, we fee how by them to express all the Seven different Orders of Tones and Semitones within the diatonick Scale. If the Scale is extended to Two 8ves, you'll perceive that by this Rule 'tis always true, tho' it were further extended in infinitum, that above mi stands fa, fol, la, and below it the same reversed la, fol, fa; and that one mi is always distant from another by an Octave, (which no other Syllable is) because after mi afcending comes always fa, fol, la, fa; fol, la, which are taken reverse descending. But now you'll ask a more particular Account of the Application of this; and that you may understand it, consider, the first Thing in teaching to fing is, to make one raise a Scale of Notes by Tones and Semitones to an Ostave, and descend again by the same Notes, and then to rife and fall by greater Intervals at a Leap, as a 3d, 4th and 5th, &c. And to do all this by beginning at Notes of different Pitch; then these Notes are represented by Lines and Spaces, as above explained, to which these Syllables are applied; 'tis ordinary therefore, to learn a Scholar to name every Line and Space by these Syllables: But still you'll ask, to what Purpose? The Answer is, That while they are learning to tune the Degrees and Intervals of Sound exprest by Notes fet upon Lines and Spaces, or learnlearning a Song to which no Words are applied, they may do it better by an articulate Sound, and chiefly that by knowing the Degrees and Intervals exprest by these Syllables, they may more readily know the true Distance of their Notes. I shall first make an End of what is to be said about the Application, and then shew

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what an nieless Invention this is.

THE only Syllable that is but once applied in Seven Letters is mi, and by applying this to different Letters, the Seat of the Two natural Semitones in the 8ve, expressed by la-fa and mi-fa, will be placed betwixt different Letters (which is all we are to notice where the Difference of the greater and leffer Tone is neglected, as in all this) But because the Relation of the Notes exprest by the seven plain Letters, c, d, e, f, g, a, b, which we call the natural Scale, are supposed to be fixt and unalterable, and the Degrees exprest by these Syllables are also fixt, therefore the natural Seat of mi is faid to be b, because then mi-fa and la-fa areapplied to the natural Semitones b.c and e.f, as you fee in the Table: But if mi is applied to any other of the Seven natural Notes, then fome of the artificial Notes will be necessary, to make a Series answering to the Degrees which we suppose are invariably exprest by these Syllables; but mi may be applied not only to any of the Seven natural Notes, it may also be applied to any of the Five artificial Ones: And now to know in any Case (i. e. when mi is applied to any of the Twelve Letters of the femitonick Scale) to what Notes

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Notes the other Syllables are applied, you need but look into the preceeding Table, where if you suppose mi applied to any Letter of that Line where it stands, the Notes to which fa, sol, la are applied are found in the same Column with that Letter, and in the same Line with these Syllables. By this Means I hope you have an easy Rule for sol-fa-ing, or naming the Notes by sol, fa, &c. in any Clef and with any

Signature.

But now let us consider of what great Im= portance this is, either to the understanding or practifing of Musick. In the first Place, the Difficulty to the Learner is increased by the Addition of these Names, which for every different Signature of the Clef are differently applied; fo that the same Line or Space is in one Signature called fa, in another fol, and so on ! And if a Song modulates into a new Key, then for every fuch Change different Applications of these Names may be required to the same Note, which will beget much Confusion and Difficulty: And if you would conceive the whole Difficulty, confider, as there are 12 different Seats of mi in the Octave, therefore the naming of the Lines and Spaces of any particular System and Clef has the same Variety; and if one must learn to name Notes in every Clef and every Polition of the Clef, then as there is one ordinary Position for the Treble-clef, one for the Bass, and Four for the mean, if we apply to each of these the 12 different Signatures, and consequent Ways of fol-fa-ing, we have

in all 72 various Ways of applying the Names of fol, fa, &c. to the Lines and Spaces of a particular System; not that the same Line can have 72 different Names, but in the Order of the Whole there is so great a Variety: And if we suppose yet more Positions of the Clefs, the Variety will still be increased, to which you must add what Variety happens upon changing the Key in the Middle of any Song. Let us next fee what the Learner has by this troublesom Acquisition: After considering it well, we find nothing at all; for as to naming the Notes, pray what want we more than the Seven Letters already applied, which are constant and certain Names to every Line and Space under all different Signatures, the Clef being the fame and in the fame Position, and how much more simple and eafy this is any Body can judge. If it be complained that the Sounds of these Letters are harth when used in rating a Series of Notes, then, because this feems to make the Use of these Names only for the fofter Pronounciation of a Note, let Seven Syllables as foft as possible be chosen and joyned invariably to the Letters or alphabetical Names of the Scale; fo that as the same Line or Space is, in the same Clef and Position, always called by the same Letter, whether is a natural or artificial Note, so let it be constantly named by the same Syllable; and thus we leave the true Distance or Interval to be found by the Degrees among the Lines and Spaces, as they are determined by the Letters applied to them; or rather, fince the Intervals

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tervals are fufficiently determined by the alphabetical Names applied to the Lines and Spaces, there is no Matter whether the fyllabical Names be conftant or not, or what Number there be of them, that is, we may apply to any Note at random any Syllable that will make the Pronounciation foft and eafy, if this be the chief End of them, as I think it can only be, because the Degrees and Intervals are better and more regularly exprest by the Clef and Signature: Nay, 'tis plain, that there is no Certainty of any Interval exprest simply by these Syllables, without confidering the Lines and Spaces with their Relations determined by the Letters; for Example, If you ask what Distance there is betwixt fol and la, the Question has different Anfwers, for 'tis either a Tone or a 5th, or one of these compounded with &ve, and fo of other Examples, as are easily feen in the preceeding Scheme: But if you ask what is betwixt fol in fuch a Line or Space, and la in such a one above or below, then indeed the Question is determined; yet 'tis plain, that we don't find the Answer by these Names fa, fol, but by the Distances of the Lines and Spaces, according to the Relations fettled among them by the Letters with which they are marked.

I know this Method has been in Credit, and I doubt will continue so with some People, who, if they don't care to have Things difficult to themselves, may perhaps think it an Honour both to them and their Art, that it appear my-starious; and some shrewd Guessers may possibly

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374 A TREATISE CHAP. XI. alledge fomething else; but I shall only say that, for the Reasons advanced, I think this an impertinent Burden upon Musick.

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Further Reflections upon the Names of Notes.

As there is a Necessity, that the Progression of the Scale of Musick, and all its Intervals, with their feveral Relations, should be distinctly marked, as is done by means of Letters reprefenting Sounds; fo it is necessary for Practice, that the Notes and Intervals of Sound upon Instruments should be named by the same Letters, by which we have feen a clear and eafy Method of expressing any Piece of Melody, for directing us how to produce the fame upon a musical Instrument: But then observe, that as the Scale of Musick puts no Limitations upon the absolute Degree of Tune, only regulating the relative Measures of one Note to another, fo the Notes of Instruments are called c, d, &c. not with respect to any certain Pitch of Tune, but to mark distinctly the Relations of one Note to another; and, without respect to the Pitch of the Whole, the same Notes, i. e. the Sounds taken in the fame Part of the Instrument, are always named by the fame Letters, because the Whole makes a Series, which is conftantly in the same Order and Relation of Degrees. For Example, Let the Four Strings of a Violin be tuned as high or low as you please, being always 5ths to one another, the Names of the Four open Notes are still called g,d,a,e, and so of the

the other Notes; and therefore, if upon hearing any Note of an Instrument we ask the Name of it, as whether it is c or d, &c. the Meaning can only be, what Part of the Instrument is it taken in, and with what Application of the Hand? For with respect to the absolute Tune it cannot be called by one Letter rather than another, for the Note which is called c, according to the foresaid general Rule, may in one Pitch of Tuning be equal to the Note called

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But for the human Voice, consider there is no fixt or limited Order of its Degrees, but an Octave may be raised in any Order; therefore the Notes of the Voice cannot be called c or d, &c. in any other Sense than as being unifon to the Note of that Name upon a fixt Instrument: Or if a whole Octave is raifed in any Order of Tones and Semitones, contained within the diatonick Scale, suppose that from c, each of these Notes may be called c, d, &c. in fo far as they express the Relations of these Notes one to another. And lastly, With respect to this Method of writing Musick, when the Voice takes Direction from it, the Notes must at that Time be called by the Letters and Names that direct it in taking the Degrees and Intervals that compose the Melody; yet the Voice may begin still in the same Pitch of Tune, whatever Name or Letter in the Writing the first Note is fet at, because these Letters serve only to mark the Relations of the Notes: But in Infruments, tho' the Tune of the Whole may be Aa4 higher.

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higher or lower, the fame Notes in the Writing direct always to the fame individual Notes with respect to the Name and the Place of the Instrument, which has nothing parallel to it in the human Voice. Again, tho' the Voice and Infirmments are both directed by the same Method of Writing Musick, yet there is one very remarkable Difference betwixt the Voice and fuch Instruments as have fixt Sounds; for the Voice being limited to no Order of Degrees, has none of the Imperfections of an Instrument, and can therefore begin in Unifon with any Note of an Inftrument, or at any other convenient Pitch, and take any Interval upward or downward in just Tune: And the' the unequal Ratios or Degrees of the Scale, when the Sounds are fixt, make many small Errors on Instruments, yet the Voice is not subjected to these: But it will be objected, that the Voice is directed by the fame Scale, whose Notes or Letters have been all along supposed under a certain determinate Relation to one another, which feems to lay the Voice under the fame Limitations with Inftruments having fixt Sounds, if it follow the precise Proportions of these Notes as they stand in the Scale: The Answer to this is, That the Voice will not, and I dare fay cannot poffibly follow thefe erroneous Proportions; becanfe the true harmonious Distances are much eafier taken, to which a good Ear will naturally lead: Consider again, that because the Errors are small in a fingle Case, and the Difference of Tones or of Semirones scarce ferifible, therefore they are g

are confidered as all equal upon Instituments; and the same Number of Tones or Semitones is. every where thro' the Scale, reckoned the fame or an equal Interval and fo it must pass with some small unavoidable Errors. Now that the Voice may be directed by the same Scale or System of Notes, the Singer will also consider them as equal, and in like manner take the same Number for the same Interval; yet, by the Direction of a well tuned Bar, will take every Interval in its due Proportion, according to the Exigences of the Melody; foif the Key is d, and the Three first Notes of a Song were set in d, e, f, the Voice will take dee a tr. and e-f a fg. in order to make d-f a true 3d l. which is defective a Comma in the Scale, because d-e is a tl. In another Case the Voice would take these very Notes according to the Scale, as here, suppose the Key c, and the first Three Notes c, d, f, the Voice will take c-d a tg. because that is a more perfect Degree than tl. and then will take f not a true 3d I to d, but a true 4th to the Key c. which the Melody requires rather than the other, whereby d-f is made a deficient 3d1; and if we suppose e is the third Note, and f the Fourth, the Voice will take e a tl above d, in order to make c-e a true 3d g. I don't pretend that thefe small Differences are very sensible in a single Case, yet 'tis more rational to think that a good Ear left to itself will take the Notes in the best Proportions, where there is nothing to determine it another Way, as the Accompanyment of an Inframent; and then it is demonstrated 378 A TREATISE CHAP. XI.

by this, that in the best tuned Instruments having fixt Sounds, the same Song will not go equally well from every Note; but let a Voice directed by a just Ear begin unison to any Note of an Instrument, there shall be no Difference: I own, that by a Habit of singing and using the Voice to one Pitch of Tune, it may become difficult to sing out of it, but this is accidental to the Voice which is naturally capable of singing alike well in every Pitch within its Extent of Notes, being equally used to them all.

APPENDIX.

Concerning Mr. Salmon's Proposal for reducing all Musick to one Clef.

*TIS certainly the Use of Things that makes them valuable; and the more universal the Application of any Good is, it is the more to their Honour who communicate it: For this Reason, no doubt, it would very well become the Professors of so generous an Art as Musick, and I believe in every respect would be their Interest, to study how the Practice of it might be made as easy and universal as possible; and to encourage any Thing that might contribute towards this End.

of Practice is much increased by the Difference of Clefs in particular Systems, whereby the same Line or Space, i. e. the first or second Line, &c.

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is fometimes called c, fometimes g. With refpect to Instruments'tis plain; for if every Line and Space keeps not constantly the same Name. the Note set upon it must be fought in a different Place of the Instrument: And with respect to the Voice, which takes all its Notes according to their Intervals betwixt the Lines and Spaces, if the Names of these are not constantneither are the Intervals constantly the same in every Place; therefore for every Difference either in the Clef or Position of it, we have a new Study to know our Notes, which makes difficult Practice, especially if the Clef should be changed in the very middle of a Piece, as is frequently done in the modern Way of writing Musick. Mr. Salmon reflecting on these Inconveniencies, and also how useful it would be that all should be reduced to one constant Clef, whereby the fame Writing of any Piece of Musick would equally ferve to direct the Voice and all Instruments, a Thing one should think to be of very great Use, he proposes in his Esfay to the Advancement of Musick, what he calls an univerfal Character, which I shall explain in a few Words. In the Ist Place, he would have the lowest Line of every particular System constantly called g, and the other Lines and Spaces to be named according to the Order of the 7 Letters; and because these Positions of the Letters are supposed invariable, therefore he thinks there's no Need to mark any of them; but then, 2do. That the Relations of feveral Parts of a Composition may be distinctly known; he marks

marks the Treble with the Letter T at the Beginning of the System; the Mean with M. and the Bafs with B. And the gs that are on the lowest Line of each of these Systems, he supposes to be Octaves to each other in Order. And then for referring these Systems to their corresponding Places in the general System, the Treble g, which determines all the rest, must be supposed in the same Place as the Treble Clef of the common Method; but this Difference is remarkable, That tho' the g of the Treble and Bass Systems are both on Lines in the general System, yet the Mean g, which is on a Line of the particular System, is on a Space in the general one, because in the Progression of the Scale, the fame Letter, as g, is alternately upon a Line and a Space; therefore the Mean System is not a Continuation of any of the other Two, fo as you could proceed in Order out of the one into the other by Degrees from Line to Space, because the g of the Mean is here on a Line, which is necessarily upon a Space in the Scale; and therefore in referring the mean System to its proper relative Place in the Scale, all its Lines correspond to Spaces, of the other and contrarily; but there is no Matter of that if the Parts be fo written feparately as their Relations be diffinelly known, and the Practice made more easy; and when we would reduce them all to one general System, it is enough we know that the Lines of the mean Part must be changed into Spaces, and its Spaces into Lines. 3110. If the Notes of any Part

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Part go above or below its System, we may set them as formerly on short Lines drawn on Purpose: But if there are many Notes together above or below, Mr. Salmon proposes to reduce them within the System by placing them on the Lines and Spaces of the fame Name, and prefixing the Name of the Octave to which they belong. To understand this better, consider, he has chosen three distinct Offaves following one another; and because one Octave needs but 4 Lines therefore he would have no more in the particular System; and then each of the three particular Systems expressing a distinct Octave of the Scale, which he calls the proper Octaves of these several Parts, if the Song run into another Octave above or below, 'tis plain, the Notes that are out of the Octave peculiar to the System, as it stands by a general Rule marked T or M or B, may be set on the same Lines and Spaces; and it the Octave they belong to be distinctly marked, the Notes may be very easily found by taking them an Octave higher or lower than the Notes of the fame Name in the proper Octave of the System. For Example, If the Treble Part runs into the middle or Bass Octave, we prefix to these Notes the Letter M or B, and fet them on the same Lines and Spaces, for all the Three Systems, have in this Hypothesis the Notes of the same Name in the same correspondent Places; if the Mean run into the Treble or Bafs Octaves, prefix the Signs T or M. And laftly, Because the Parts may comprehend more than 3 0-Etaves

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ctaves, therefore the Treble may run higher than an Octave, and the Bass lower; in such Cases, the higher Octave for the Treble may be marked Tt. and the lower for the Bals Bb. But if any Body thinks there be any confiderable Difficulty in this Method, which yet I'm of Opinion would be far less than the changing of Clefs in the common Way, the Notes may be continued upward and downward upon new Lines and Spaces, occasionally drawn in the ordinary Manner, and tho' there may be many Notes far out of the System above or below, yet what's the Inconveniency of this? Is the reducing the Notes within 5 Lines, and faving a little Paper an adequate Reward for the Trouble and Time spent in learning to perform readily from different Clefs ?

As to the Treble and Bass, the Alteration by this new Method is very small; for in the common Position of the Bass-clef, the lowest Line is already g; and for the Treble it is but removing the g from the 2d Line, its ordinary Position, to the first Line; the greatest Innovation is in the Parts that are set with the c Clef.

And now will any Body deny that it is a great Advantage to have an universal Character in Musick, whereby the same Song or Part of any Composition may, with equal Ease and Readiness be performed by the Voice or any Instrument; and different Parts with alike Ease by the same Instrument? 'tis true that each Part is marked with its own Octave, but the Design of this is only to mark the Relation of the

the Parts, that feveral Voices or Instruments performing these in a Concert may be directed to take their first Notes in the true Relations which the Compoter defigned; but if we fpeak of any one fingle Part to be fung or performed alone by any Instrument, the Performer in this case will not mind the Distinction of the Part, but take the Notes upon his Instrument, according to a general Rule, which teaches him that a Note in fuch a Line or Space is to be taken in fuch a certain Place of the Instrument. You may see the Proposal and the Applications the Author makes of it at large in his Essay, where he has considered and anfwered the Objections he thought might be raifed; and to give you a fhort Account of them, consider, that besides the Ignorance and Superstition that haunts little Minds, who make a Kind of Religion of never departing from received Customs, whatever Reason there may be for changing; or perhaps the Pride and Vanity of the greatest Part of Professors of this Art, joyned to a falfe Notion of their Interest in making it appear difficult, for the rational Part of any Set and Order of Men is always the least; besides these, I say, the greatest Difficulty feems to be, the rendring what is already printed useless in part to them that shall be taught this new Method, unless they are to learn both, which is rather enlarging than lessening their Task: But this new Method is fo eafy, and differs so little in the Bass and Treble Parts, from what obtains already, that I think it would add

add very little to their Task, who by the common Method, must learn to fing and play from all Clefs and Variety of Politions; and then Time would wear it out, when new Musick were printed, and the former reprinted in the Manner proposed. Mr. Salmon has been a Prophet in gueffing what Fate it was like to have; for it has lain Fifty Years neglected: Nor do I revive it with any better Hope. I thought of nothing but confidering it as a Piece of Theory, to explain what might be done, and inform you of what has been proposed. I cannot however hinder my felf to complain of the Hardships of learning to read eleverly from all Clefs and Positions of them: If one would be fo univerfally capable in Mufick as to fing or play all Parts, let him undergo the Drudgery of being Master of the Three Clefs; but why may not the Politions be fixt and unalterable? And why may not the fame Part be constantly fet with the same Clef, without the Perplexity of changing, that those who confine themselves to one Instrument, or the Performance of one Part, may have no more to learn than what is necessary? This swould fave a great deal of Trouble that's but forrily recompensed by bringing the Notes within or near the Compass of Five Lines, which is all can be alledged, and a very filly Purpose confidering the Confequence.

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CHAP. XII.

Of the Time or Duration of Sounds in Musick.

fion into absolute and relative; and particularly of the Names, Signs, and Proportions, or relative Measures of Notes, as to Time

W E are now come to the second general Branch of the Theory of Musick, which is to consider the Time or Duration of Sounds in the same Degree of Tune.

TUNE and TIME are the Affections or Properties of Sound, upon whose Difference or Proportions Musick depends. In each of these ingly there are very powerful Charms: Where the Duration of the Notes is equal, the Differences of Tune are capable to entertain us with an endless Variety of Pleasure, either in an artifull

ful and well ordered Succession of simple Sounds, which is Melody, or the beautiful Harmony of Parts in Confonance: And of the Power of Time alone, i. e. of the Pleasure arising from the various Measures of long and short, or swift and flow in the Succession of Sounds differing only in Duration, we have Experience in a Drum, which has no Difference of Notes as to Tune. But how is the Power of Musick heightned, when the Differences of Tune and Time are artfully joined: 'Tis this Composition that can work fo irrefiftibly on the Passions, to make one heavy or cheerful; it can be fuited to Occafions of Mirth or Sadness; by it we can raise, and at least indulge, the folemn composed Frame of our Spirits, or fink them into a trifling Levity: But enough for Introduction.

In explaining this Part there is much less to do than was in the former; the Causes and Meafures of the Degrees of Tune, with the Intervals depending thereon: And all their various Connections and Relations, were not so easily discovered and explained, as we can do what relates to this, which is a far more simple Subject.

THE Reason or Cause of a long or short Sound is obvious in every Case; and I may say, in general, it is owing to the continued Impulse of the efficient Cause, for a longer or shorter Time upon the sonorous Body; for I speak here of the artful Duration of Sound. See Page 17. where I have explained the Distinction betwixt natural and artisicial Duration, to which I shall here

here add the Confideration of those Instruments that are struck with a Kind of instantaneous Motion, as Harpsichords and Bells, where the Sounds cannot be made longer or shorter by Art; for the Stroke cannot be repeated fo oft as to make the Sound appear as one continued Note; and therefore this is supplied by the Paule and Distance of Time betwixt the striking one Note and another, i. e. by the Quicknefs or Slowness of their Succession; so that long and short, quick and slow are the same Things in Musick; therefore under this Title of the Duration of Sounds, must be comprehended that of the Quickness or Slowness of their Succession, as well as the proper Notion of Length and Shortness: And so the Time of a Note is not computed only by the uninterrupted Length of the Sound, but also by the Distance betwixt the Beginning of one Sound and that of the next. And mind that when the Notes are in the strict Sense long and short Sounds, yet speaking of their Succession we say also, that it is quick or flow, according as the Notes are thort or long, which Notion we have by confidering the Lime from the Beginning of one Note to that of another.

Next, as to the Measure of the Duration of a Note, if we chuse any sensibly equal Motion, as the Pulses of a well adjusted Clock or Watch, the Duration of any Note may be measured by this, and we may justly say, that it is equal to 2, 3 or 4, Gc. Pulses; and if any other Note is compared to the same Motion,

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we shall have the exact Proportion of the Times of the Two, exprest by the different Number of Pulses. Now, I need give no Reason to prove, that the Time of a Note is justly measured by the fuccessive Parts of an equable Motion; for tis felf-evident, that it cannot be better done; and indeed we know no other Way of meafuring Time, but by the Succession of Ideas in our own Minds.

WE come now to examine the particular Measures and Proportions of Time that belong to Musick; for as in the Matter of Tune, every Proportion is not fit for obtaining the Ends of Mufick, fo neither is every Proportion of Time; and to come close to our Purpose, ob-

ferve.

TIME in Musick is to be considered either with respect to the absolute Duration of the Notes, i. e. the Duration confidered in every Note by it felf, and measured by some external Motion foreign to the Musick; in respect of which the Succession of the whole is faid to be quick or flow: Or, it is to be confidered with respect to the relative Quantity or Proportion of the Notes, compared one with another.

Now, to explain these Things, we must first know what are the Signs by which the Time of Notes is represented. The Marks and Characters in the modern Practice are these Six, whose Figures and Names you fee in Plate 2. Fig. 3. And observe, when Two or more Quavers or Semiquavers come together, they are made with one or Two Strokes across their Tails es of

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Tails, and then they are called tied Notes. These Signs express no absolute Time, and are in different Cases of different Lengths, but their Measures and how they are determined, we shall learn again, after we have considered,

The relative Quantity or Proportions of Time.

THIS Proportion I have fignified by Numbers written over the Notes or Signs of Time; whereby you may see a Semibreve is equal to Two Minims, a Minim equal to Two Crotchets, a Crotchet equal to Two Quavers, a Quaver equal to Two Semiquavers, a Semiquaver equal to Two Demi-semiquavers. The Proportions of Length of each of these to each other are therefore manifest: I have set over each of them Numbers which express all their mutual Proportions; fo a Minim is to a Quaver as 16 to 4, or 4 to 1, i. e. a Minim is equal to Four Quavers, and so of the rest. Now these Proportions are double, (i. e. as 2:1) or compounded of feveral Doubles, so 4: 1 contains 2:1 twice; but there is also the Proportion of 3:1 used in Musick: Yet that this Part may be as simple and easy as possible, these Proportions already stated among the Notes, are fixt and invariable; and to express a Proportion of 3 to 1 we add a Point (.) on the right Side of any Note, which is equal to a Half of it, where by a pointed Semibreve is equal to Three Minims, and so of the rest, as you fee in the Figure. From these arise other Proportions, as of 2 to 3, which is betwixt any Note (as a Crotchet) B b 3

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Crotchet) plain, and the same pointed; for the plain Crotchet is Two Quavers, and the pointed is Three. Also we have the Proportion of 3 to 4, betwixt any Note pointed, and the Note of the next greater Value plain, as betwixt a pointed Crotchet and a plain Minim. And of these arise other Proportions, but we need not trouble our selves with them, since they are not directly useful; and that we may know what are so, suffer me to repeat a little of what I have

faid elsewhere, viz. that

THINGS that are designed to affect our Senses. must bear a due Proportion with them; and so where the Parts of any Object are numerous, and their Relations perplext, and not eafily perceived, they can raife no agreeable Ideas; nor can we easily judge of the Difference of Parts where it is great; therefore, that the Proportion of the Time of Notes may afford us Pleafure, they must be such as are not difficultly perceived: For this Reafon the only Ratios fit for Musick, besides that of Equality, are the double and triple, or the Ratios of 2 to 1 and 3 to 1; of greater Differences we could not judge, without a painful Attention; and as for any other Ratios than the multiple Kind (i.e. which are as 1 to fome other Number) they are still more perplext. 'Tis true, that in the Proportions of Tune the Ratios of 2:3, of 3:4, Oc. produce Concord; and tho' we conclude these to be the Proportions, from very good Reasons, yet the Ear judges of them after a more fubtil Manner; or rather indeed we are conscious of no such Thing

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Thing as the Proportions of the different Numbers of Vibrations that conflitute the Intervals of Sound, tho' the Agreeableness or Disagreeableness of our Sensations seem to depend upon it, by some secret Conformity of the Organs of Sense with the Impulse made upon them in these Proportions; but in the Business of Time, the good Essect depends entirely upon a distinct

Perception of the Proportions.

Now, the Length of Notes is a Thing merely accidental to the Sound, and depends altogether upon our Will in producing them: And to make the Proportions distinct and perceivable, fo that we may be pleafed with them, there is no other Way but to divide the Two Notes compared into equal Parts; and as this is easier done in multiple Proportions, because the shorter Note needs not be divided, being the Divisor or Measure of the imaginary Parts of the other, so 'tis still easier in the first and more simple Kind as 2 to 1, and 3 to 1; and the Necessity of fuch simple Proportions in the Time is the more, that we have also the Intervals of Tune to mind along with it. But obferve, that when I say the Ratio of Equality, and those of 2 to 3 and 3 to 1, are the only Ratios of Time fit for Musick, I do not mean that there must not be, in the same Song, Two Notes in any other Proportion; but you must take it this Way, viz. that of Two Notes immediately next other, these ought to be the Ratios, because only the Notes in immediate Succession are or can be directly minded, in pro-B b 4 porportioning the Time, whereof one being taken at any Length, the other is measured with relation to it, and fo on: And the Proportions of other Notes at Distances I call accidental Proportions. Again observe, that even betwixt Two Notes next to other, there may be other Proportions of greater Inequality, but then it is betwist Notes which the Ear does not directly compare, which are separate by some Pause, as the one being the End of one Period of the Song, and the other the Beginning of another; or even when they are separate by a less Pause, as a Bar (which you'll have explained presently.) Sometimes also a Note is kept out very long, by connecting feveral Notes of the fame Value, and directing them to be taken all as one, but this is always fo ordered that it can be eafily fubdivided in the Imagination, and especially by the Movement of some other Part going along, which is the ordinary Cafe where these long Notes happen, and then the Melody is in the moving Part, the long Note being defigned only for Harmony to it; fo that this Case is no proper Exception to the Rule, which relates to the Melady of fuccessive Sounds, but here the Melody is transferred from the one Part to another. And lastly, consider that it is chiefly in brisk Movements, where neither of the Two Notes is long, that no other Proportions betwixt them than the simple ones mentioned are admitted.

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Modes, or Constitution of Parts of a Piece of Melody, on which the different Airs in Musick depend, and particularly of the Diftination of common and triple Time, and the Description of the Chronometer for measuring it.

ROM the Principles mentioned in the last Article, we conclude that there are certain Limits beyond which we must not go, either in Swiftness or Slowness of Time, i.e. Length or Shortness of Notes; and therefore let us come to Particulars, and explain the various Quantities, and the Way of measuring them.

In order to this we must here consider another Application of the preceeding Principles, which is, that a Piece of Melody being a Compolition of many Notes faccessively ranged, and heard one after another, is divisible into several Parts; and ought to be contrived fo as the feveral Members may be easily distinguished, that the Mind, perceiving this Connection of Parts constituting one Whole, may be delighted with it; for 'tis plain where we perceive there are Parts, the Mind will endeavour to distinguish them, and when that cannot be easily done, we must be so far disappointed of our Pleasure. Now a Division into equal Parts is, of all others, the most simple and easily perceived; and in the present Case, where so many other Things require our Attention, as the various ComCombinations of Tune and Time, no other Di-

vision can be admitted: Therefore,

EVERY Song is actually divided into a certain Number of equal Parts, which we call Bars (from a Line that separates them, drawn straight across the Staff, as you see in Plate 2.) or Measures, because the Measure of the Time is laid upon them, or at least by means of their Subdivisions we are assisted in measuring it; and therefore you have this Word Measure used sometime for a Bar, and sometime for the absolute Quantity of Time; and to prevent Ambiguity, I shall afterwards write it in Italick when I mean a Bar.

By faying the Bars are all equal I mean that, in the same Piece of Melody, they contain each the fame Number of the fame Kind of Notes, as Minims or Crotchets, &c. or that the Sum of the Notes in each (for they are varioully fubdivided) reckoned according to their Ratios one to another already fixt, is equal; and every Note of the fame Name, as Crotchet, &c. must be made of the same Time through the whole Piece, consequently the Times in which the feveral Bars are performed are all equal; fee the Examples of Plate 3. But what that Time is, we don't yet know; and indeed I must fay it is a various and undetermined Thing, Different Purposes, and the Variety which we require in our Pleasures, make it necessary that the Measures of a Bar, or the Movement with respect to quick and flow, be in some Pieces greater, and in others leffer;

leser; and this might be done by having the Quantity of the Notes of Time fixt to a certain Measure, fo that wherever any Note occurred it should always be of the same Time; and then when a quick Movement were deligned, the Notes of shorter Time would ferve, and the longer for a flow Time; and for determining these Notes we might use a Pendulum of a certain Length, whose Vibration being the fixt Measure of any one Note, that would determine the rest; and it would be best if a Crotchet were the determined Note, by the Subdivision or Multiplication whereof, we could eafily meafure the other Notes; and by Practice we might eafily become familiar with that Meafure; but as this is not the Method agreed upon, tho' it feems to be a very rational and eafy one, I shall not insist upon it here.

In the present Practice, tho' the same Notes of Time are of the same Measure in any one Piece, yet in different Pieces they differ very much, and the Differences are in general marked by the Words flow, brisk, swift, &c. written at the Beginning; but still these are uncertain Measures, since there are different Degrees of flow and swift; and indeed the true Determination of them must be learnt by Experience from the Practice of Musicians; yet there are some Kind of general Rules commonly delivered to us in this Matter, which I shall shew you, and at the same Time the Method used for assisting us to give each Note its true Proportion, according to the Measure or determined

Quantity of Time, and for keeping this equal thro' the Whole. But in order to this, there is another very confiderable Thing to be learnt, concerning the Mode or Constitution of the Measure; and first observe, That I call this Difference in the absolute Time the different Movements of a Piece, a Thing very distinct from the different Measure or Constitution of the Bar, for feveral Pieces may have the fame Measure, and a different Movement. Now by this Constitution is meant the Difference with respect to the Quantity of the Measure, and the particular Subdivision and Combination of its Parts; and by the total Quantity, I understand that the Sum of all the Notes in the Measure reckoned according to their fixt Relation, is equal to some one or more determined Notes, as to one Semibreve or to Three Minims or Crotchets, &c. which yet without some other Determination is but relative: And in the Subdivision of the Measure the Thing chiefly confidered is, That it is divisible into a certain Number of equal Parts, fo that, counting from the Beginning of the Measure, each Part shall end with a Note, and not in the Middle of one (tho' this is also admitted for Variety;) for Example, if the Measure contain 3 Minims, and ought to be divided into Three equal Parts, then the Subdivision and Combination of its leffer Parts ought to be fuch, that each Part, counting from the Beginning, shall be composed of a precise Number of whole Notes, without breaking in upon any Note; so if the first Note

were a Crotchet, and the second a Minim, we could not take the first 3d Part another Way

than by dividing that Minim.

WE considered already how necessary it is that the Ratios of the Time of successive Notes be simple, which for ordinary are only as 2 to 1, or 3 to 1, and in any other Cales are only the Compounds of these Ratios, as 4 to 1; so in the Constitution of the Measure, we are limited to the same Ratios, i. e. the Measures are only subdivided into 2 or 3 equal Parts; and if there are more, they must be Multiples of these Numbers as 4 to 6, is composfed of 2 and 3; again observe, the Measures of feveral Songs may agree in the total Quantity, yet differ in the Subdivision and Combination of the leffer Notes that fill up the Measure; also those that agree in a similar or like Combination or Subdivision of the Measure, may yet differ in the total Quantity. But to come to Particulars.

Of common and triple Time.

THESE Modes are divided into Two general Kinds, which I shall call the common and triple Mode, called ordinarily common and triple Time.

1. COMMON TIME is of Two Species; the if where every Measure is equal to a Semibreve, or its Value in any Combination of Notes of a leffer relative Quantity; the 2d, where every Measure is equal to a Minim, or its Value in tesser Notes. The Movements of this Kind of Medfure are very various; but there are Three common Distinctions, the first is flow, signified

at the Beginning by this Mark C, the 2d is brisk, fignified by this Q, the 3d is very quick fignified by this D; but what that flow, brisk, and quick is, is very uncertain, and, as I have faid already, must be learned by Practice : The nearest Measure I know, is to make a Quarer the Length of the Pulse of a good Watch, and fo the Crotchet will be equal to 2 Pulses, a Minim equal to 4, and the whole Measure or Semibreve equal to 8 Pulses; and this is very near the Measure of the brisk common Time, the flow Time being near as long again, as the quick is about half as long. Some propose to measure it thus, viz. to imagine the Bar as actually divided into 4 Crotchets in the first Species, and to make the whole as long as one may diftinctly pronounce these Four Words, One, two, three, four, all of equal Length; fo that the first Crotchet may be applied to One, the 2d to Two, &c. and for other Notes proportionally; and this they make the brisk Movement of common Time; and where the Bar has but Two Crotchets, then 'tis measured by one, two: But this is still far from being a certain Meafure. I shall propose some other Method prefently, mean while

LET us suppose the Measure or Quantity fixt, that we may explain the ordinary Method practifed as a Help for perferving it equal thro'

the whole Piece.

THE total Measure of common Time is equal to a Semibreve or Minim, as already faid; but these are variously subdivided into Notes of leffer

lesser Value. Now to keep the Time equal, we make use of a Motion of the Hand, or Foot (if the other is employed,) thus; knowing the true Time of a Crotchet, we shall suppose the Meafure actually subdivided into 4 Crotchets for the first Species, and the half Measure will be 2 Crotchets, therefore the Hand or Foot being up, if we put it down with the very Beginning of the first Note or Crotchet, and then raise it with the Third, and then down with the Beginning of the next Measure, this is called Beating the Time; and by Practice we acquire a Habit of making this Motion very equal, and confequently of dividing the Measure in Two equal Parts: Now whatever other Subdivision the Measure consists of, we must calculate, by the Relation of the Notes, where the first Half ends, and then applying this equable Motion of the Hand or Foot, we make the first as long as the Motion down (or as the Time betwixt its being down and raifed again, for the Motion is frequently made in an Instant; and the Hand continues down for fome Time,) and the other Half as long as the Motion up (or as the Hand remains up,) and having the half Measure thus determined, Practice very foon learns us to take all the Notes that compose it in their true Proportion one to another, and fo as to begin and end them precisely with the beating. In the Measure of Two Crotchets, we beat down the first and the fecond up.

of the Measure, in common Time, A. TIME; and

400 A TREATISE CHAP. XII. and so they call this the Mode or Measure of

Two Times, or the Dupla-measure. Again you'll find some mark the Measure of Two Crotchets with a 2 or $\frac{1}{4}$, signifying that 'tis equal to Two Notes, whereof 4 make a Semi-breve; and some also marked $\frac{1}{8}$ which is the

very fame Thing, i. e. 4 Quavers.

2. TRIPLE TIME consists of many different Species, whereof there are in general 4, each of which have their Varieties under it; and the common Name of Triple is taken from this, that the Whole or Half Measure is divisible into 3 equal Parts, and so beat.

THE 2d Species is the mixt Triple: its Measure is equal to 6 Crotchets or 6 Quavers or 6 Semiquavers, and accordingly marked for for so but the last is seldom used. Some Authors add other Two, viz. 6 Semibreves and 6 Minims, marked for for but these are not in use. The Measure here is ordinarily divided into Two equal Parts or Times, whereof one is beat down, and one up; but it may also be divided into 6 Times, whereof the first Two are beat

beat down, and the 3d up, then the next Two down and the last up, that is, beat each Half of the Measure like the simple Triple (upon which Account it may also be called a compound Triple,) and because it may be thus divided either into Two or 6 Times (i.e. Two Triples) its called mixt, and by some called the Measure of 6 Times.

THE 3d Species is the compound Triple, confilting of 9 Crotchets, or Quavers or Semiquavers marked thus $\frac{2}{4}$, $\frac{2}{8}$, $\frac{2}{16}$; the first and the last are little used, and some add $\frac{2}{1}$ which are never used. This Measure is divided either into 3 equal Parts or Times, whereof Two are beat down and one up; or each Third Part of it may be divided into 3 Times, and beat like the simple Triple, and for this 'tis called the

Measure of 9 Times.

The 4th Species is a Compound of the 2d Species, containing 12 Crotchets or Quavers or Semiquavers marked 12 13 16, to which fome add 2 and 2 that are not used; nor are the 1st and 3d much in Use, especially the 3d. The Measure here may be divided into Two Times, and beat one down and one up; or each Half may be divided and beat at the 2d Species, either by Two or Three, in which Case it will make in all 12 Times, hence called the Measure of 12 Times. See Examples of the most ordinary Species in Plate 3d.

Now as to the Movement of these several Kinds of Measures both duple and triple, 'tis various; and as I have said, it must be learned by Practice; yet ere I leave this Part, I shall make these general Observations, First. That the Movement in every Piece is ordinarily marked by fuch Words as flow, fwift, &c. But because the Italian Compositions are the Standard and Model of the better Kind of modern Musick, I shall explain the Words by which they mark their Movements, and which are generally used by all others in Imitation of them: They have 6 common Diftinctions of Time, expressed by these Words, grave, adagio, largo, vivace, allegro, presto, and sometimes prestissimo. The first expresses the slowest Movement, and the rest gradually quicker; but indeed they leave it altogether to Practice to determine the precise Quantity. 2do. The Kind of Measure influences the Time exprest by these Words, in respect of which we find this generally true, that the Movements of the same Name, as adagio or allegro, &c. are fwifter in triple than in common Time. 3tio. We find common Time of all these different Movements; but in the triple, there are some Species that are more ordinarily of one Kind of Movement than another: Thus the triple 3 is ordinarily adagio, fometimes vivace; the 3 is of any Kind from adagio to allegro; the 3 is allegro, or vivace; the 2 8 are more frequently allegro; the 's is fometimes adagio but oftner allegro. Yet after all, the allegro of one Species of triple is a quicker Movement than that of another, fo very uncertain these Things arc.

THERE is another very confiderable Thing to be minded here, viz. that the Air or Hu-

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mour of a Song depends very much upon these different Modes of Time, or Constitutions of the Measure, which joined with the Variety of Movements that each Mode is capable of, makes this Part of Musick wonderfully entertaining; but we must be acquainted with practical Mufick to understand this perfectly; yet the following general Things concerning the Species of Triple, may be of some Use to remark.

imo. As to the Differences in each Species, fuch price than Reason; for the same Piece of Melody may be fet in any of these Ways without loling any Thing of its true Air, fince the Relation of the Notes are invariable, and there is no certain Quantity of the absolute Time, which is left to the arbitrary Direction of these Words,

adagio, allegro, &c.

2do. Or the feveral Species of triple, there are some that are of the same relative Meafure, as $\frac{3}{4}$. $\frac{6}{8}$; and $\frac{3}{4}$. $\frac{6}{8}$; these are so far of the same Mode as the Measure of each contains the same total Quantity; for Three Minims and Six Crotchets and Twelve Quavers are equal, and fo are Three Crotchets equal to Six Quavers; but the different Constitutions of the Measure, with respect to the Subdivisions and Connections of the Notes, make a most remarkable Difference in the Air: For Example, The Time of confifts generally of Minims, and these sometimes mixt with Semilreves or with Crotchets. and some Bars will be all Crotchets; but it is contrived so that the Air requires the C C 2 Measure

Measure to be divided and beat by Three Times, and will not do another Way without manifestly changing and spoiling the Humour of the Song: Suppose we would beat it by Two Times. the first Half will always (except when the Measure is actually divided into Six Crotchets. which is very feldom) end in the Middle, or within the Time of some Note; and tho' this is admitted fometimes for Variety (whereof afterwards) yet it is rare compared with the general Rule, which is, to contrive the Division of the Measure so that every Down and Up of the Beating shall end with a particular Note; for upon this depends very much the Distinctness and, as it were, the Sense of the Melody; and therefore the Beginning of every Time, or Beating in the Measure, is reckoned the accented Part thereof. For the Time 4 it confifts of Crotchets fometimes mixt with Quavers, and even with Minims, but so ordered that 'tis either dupla or tripla, as above explained, which makes a great Difference in the Air. The Time is also mixt of dupla and tripla, and confifts generally of Quavers, and fometimes of Crotchets, but these are tied always by Three; and we have the Bar frequently composed of Twelve Quavers tied Three and Three; which, if we should ty Two and Two, would quite alter the Air: The Reafon is, That in this Mode there are in each Bar Four remarkably accented Parts, which are distant from each other by Three Quavers; and the true Reason of tying the Quavers in that manner, feems to me H.

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me to be, the marking out these distinct Parts of the Measure; but when the Quavers are tied in even Numbers by Two or Four, or by Six, it supposes the Accent upon the 1st, 3d, and 5th Quaver; which gives another Air to the Melody, and always a wrong one, when the skilful Composer designed it otherwise. The same Reasons take place in the Difference of these Times 3.3; the first consists more ordinarily of Crotchets, and Quavers tied in even Numbers, because 'tis divided into Three Parts or Times; but the other is mixt of dupla and tripla, and therefore 'tis tied in Threes, unless it be subdivided into Semiquavers, and then these are tied in even Numbers, because Two Semiqua-

vers make a Quaver.

AGAIN, there is another Question to be confidered here, viz. What is the real Difference betwixt \frac{2}{3} and \frac{6}{4}, and betwixt \frac{3}{8}, \frac{6}{8} and \frac{12}{8} ? The Lengths of the feveral Strains, or more general Periods of the Song, depend upon these, which make a confiderable Difference; but their principal Difference lies in the proper Movements of each, and a certain Choice of the fuccessive Notes that agree only with that Movement; so is always allegro, and would have no agreeable Air if it were performed adagio or largo: Another Thing is, that the Bcginning of each Bar is a more distinct and accented Part than the Beginning of any Time in the Middle of a Bar, and therefore if we should take a Piece fet 4, and subdivide its Bars to make it 3, there would be Hazard of separat-

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ing Things that ought to stand in a closer Connection; and if we put Two Bars in one of a Piece set \(\frac{2}{3}\), to make it \(\frac{5}{3}\), then we should joyn Things that ought to be distinct: But I doubt I have already said more than can be well understood without some Acquaintance with the Practice; yet there is one Thing I cannot omit here, viz. that in common Time we have insome Cases Quavers tied by Threes, and the Number 3 written over them, to signify that these Three are only the Time of other Two Qua-

vers of that Measure.

OBSERVE, in explaining what a Bar or Measure is, I have faid that all the Measures of the same Piece of Melody or Song, are of equal relative Value; and the Differences in this respect are brought under the Distinction of different Modes and Species; but that is taking the Unity of the Piece in the strictest Sense. We have alfo a Variety of fuch Pieces united in one principal Key, and fuch an Agreement of Air as is confistent with the different Modes of Time: and fuch a Composition of different Airs is called, in a large Senfe, one Piece of Melody, under the general Name of Sonata if 'tis deligned only for Instruments, or Cantata if for the Voice; and these several lesser Pieces have also different Names, fuch as Allemanda, Gavotta, &c. (which are always common Time) Minuet, Sarabanda, Giga, Corrante, Siciliana, &c. which are triple Time.

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Of the CHRONOMETER.

I have spoken a little already of the measuring the absolute Time, or determining the Movement of a Piece by means of a Pendulum, a Vibration of which being applied to any one Note, as a Crotchet, the rest might be easily determined by that Monsieur Loulie in his Elemens, ou Principes de Musique, proposes for this Purpose a yery simple and easy Machine of a Pendulum, which he calls a CHRONOMETER; it consists of one large Ruler or Piece of Board, Six Foot or Seventy Two Inches long, to be fet on End; it is divided into its Inches, and the Numbers fet fo as to count upward; and at every Division there is a small round Hole, thro' whose Center the Line of Division runs. Top of this Ruler, about an Inch above the Division 72, and perpendicular to the Ruler is inferted a small Piece of Wood, in the upper Side of which there is a Groove, hollowed along from the End that stands out to that which is fixt in the Ruler, and near each End of it a Hole is made: Thro' these Holes a Pendulum Chord is drawn, which runs in the Groove; at that End of the Chord that comes thro' the Hole furthest from the Ruler the Ball is hung, and at the other End there is a small wooden Pin which can be put in any of the Holes of the Ruler; when the Pin is in the upmost Hole at 72, then the Pendulum from the Top to the Center of Cc 4 the

the Ball, must be exactly Seventy Two Inches; and therefore whatever Hole of the Ruler it is put in, the Pendulum will be just so many Inches as that Figure at the Hole denotes. The Use of this Machine is; the Composer lengthens or shortens his Pendulum till one Vibration be equal to the defigned Length of his Bar, and then the Pin stands at a certain Division, which marks the Length of the *Pendulum*; and this Number being fet with the Clef, at the Beginning of the Song, is a Direction to others how to use the Chronometer in measuring the Time according to the Composer's Delign; for, with the Number is set the Note (Crotchet or Minim) whose Value he would have the Vibration to be; which in brisk common Time is best a Minim or half Bar, or even a whole Bar when that is but a Minim, and in flow Time a Crotchet : In triple Time it will do well to be the 3d Part, or Half or 4th Part of a Bar; and in the simple Triples that are allegro, let it be a whole Bar. And it in every Time that is allegro, the Vibration is applied to a whole or half Bar, Practice will teach us to subdivide it justly and equally. And mind, to make this Machine of universal Use, some canonical Measure of the Divisions must be agreed upon, that the Figure may give a certain Direction for the Length of the Pendulum.

§ 3. Concerning Rests or Pauses of Time; and fome other necessary Marks in writing Musick.

A S Silence has very powerful Effects in Oratory, when it is rightly managed, and brought in agreeable to Circumstances, so in Mulick, which is but another Way of expressing and exciting Passions, Silence is sometimes used to good Purpose: And tho it may be necessary in a fingle Piece of Melody for expressing some Pailion, and even for the Pleasure depending on Variety, where no Passion is directly minded, yet it is used more generally in Symphonetick Compositions; for the fake of that Beauty and Pleasure we find in hearing one Part move on while another refts, and this interchangeably; which being artfully contrived, has very good Effects. But my Business in this Place is only to let you know the Signs or Marks by which this Silence is expressed.

THESE Refts are either for a whole Bar, or more than one Bar, or but the Part of a Bar: When it is for a Part of a Bar, then it is expressed by certain Signs corresponding to the Quantity of certain Notes of Time, as Minim, Crotchet, &c. and are accordingly called Minim-refts, Crotchet-refts, &c. See their Figure in Plate 2. Fig. 3. where the Note and corresponding Rest are put together;

and

and when any of these occur either on Line or Space, for 'tis no Matter where they are fet, that Part is always filent for the Time of a Minim or Crotchet, &c. according to the Nature of the Reft. A Rest will be sometimes for a Crotchet and Quaver, or for other Quantities of Time, for which there is no particular Note; in this Case the Signs of Silence are not multiplied or made more difficult than those of Sound, but fach a Silence is marked by placing together as many Rests of different Time as make up the whole designed Rest; which makes the Practice more eafy, for by this we can more readily divide the Measure, and give the just Allowance of Time to the Rests: But let Practice fatisfie you of these Things.

WHEN the Rest is for a whole Bar, then the Semibreve Rest is always used, both in common and triple Time. It the Rest is for Two Meatures, then it is marked by a Line drawn cross a whole Space, and cross a Space and an Half for Three Measures, and cross Two Spaces for Four Measures, and so on as you see marked in the Place above directed. But to prevent all Ambiguity, and that we may at Sight know the Length of the Rest, the Number of Bars is ordinarily written over the Place where these

Signs stand.

I know some Writers speak differently about these Rests, and make some of them of different Values in different Species of triple Time: For Example, they say, that the Figure of what is the Minim-rest in common Time, expresses the Rest

Rest of Three Crotchets; and that in the Triples & 12 12 12 it marks always an half Measure, however different these are among themselves: Again, that the Rest of a Crotchet in common Time is a Rest of Three Quavers in the Triple & and that the Quaver-rest of common Time is equal to Three Semiquavers in the triple & But this Variety in the Use of the same Signs is now generally laid aside, if ever it was much in Fashion; at least there is a good Reason why it ought to be out, for we can obtain our End easier by one constant Value of these Marks

of Silence, as they are above explained.

THERE are some other Marks used in writing of Musick, which I shall explain, all of which you'll find in Plate 2. A single Bar is a Line across the Staff, that separates one Meafure from another. A double Bar is Two parallel Lines across the Staff, which separates the greater Periods or Strains of any particular or simple Piece. A Repeat is a Mark which fignifies the Repetition of a Part of the Piece; which is either of a whole Strain, and then the double Bar, at the End of that Strain, which is repeated, is marked with Points on each Side of it; and some make this the Rule, that if there are Points on both Sides, they direct to a Repetition both of the preceeding and following Strain, i. e. that each of them are to be play'd or fung twice on End; but if only one of thefe Strains ought to be repeated, then there must be Points only on that Side, i. a on the left, if it is the preceeding, or the Right if the following Strain: When only a Part of a Strain is to be repeated, there is a Mark fet over the Place where that Repetition begins, which continues to the End of the Strain.

A Direct is a Mark fet at the End of a Staff, especially at the Foot of a Page, upon that Line or Space where the first Note of the next Staff

is fet.

You'LL find a Mark, like the Arch of a Circle drawn from one Note to another, comprehending Two or more Notes in the fame or different Degrees; if the Notes are in different Degrees, it signifies that they are all to be fung to one Syllable, for Wind-instruments that they are to be made in one continued Breath, and for stringed Instruments that are struck with a Bow, as Violin, that they are made with one Stroke. If the Notes are in the same Degree, it fignifies that 'tis all one Note, to be made as long as the whole Notes fo connected; and this happens most frequently betwixt the last Note of one Bar and the first of the next, which is particularly called Syncopation, a Word also applied in other Cases: Generally, when any Time of a Measure ends in the Middle of a Note, that is, in common Time, if the Half or any of the 4th Parts of the Bar, counting from Beginning, ends in the Middle of a Note, in the simple Treble if any 3d Part of the Measure ends within a Note, in the compound Treble it any 9th Part, and in the Two mixt Triples, if any 6th or 12th Part ends in the Middle of any

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any Note, 'tis called Syncopation, which properly fignifies a striking or breaking of the Time, because the Distinctness of the several Times or Parts of the Measure is as it were hurt or interrupted hereby, which yet is of good Use in

Musick as Experience will teach.

You'll find over some single Notes a Mark like an Arch, with a Point in the Middle of it which has been used to signific that that Note is to be made longer than ordinary, and hence called a Hold; but more commonly now it signifies that the Song ends there, which is only used when the Song ends with a Repetition of the first Strain or a Part of it; and this Repetition is also directed by the Words, Da capo, i. e. from the Beginning.

OVER the Notes of the Bass-part you'll find Numbers written, as 3.5, &c. these direct to the Concords or Discords, that the Composer would have taken with the Note over which they are set, which are as it were the Substance of the Bass, these others being as Ornaments, for the greater Variety and Plea-

fure of the Harmony.

CHAP. XIII.

Containing the general Principles and Rules of HARMONICK COMPOSITION.

§ t. DEFINITIONS.

t. Of Melody and Harmony and their Ingredients.

HO' these, and also the next Definition concerning the Key, have been already largely explained; yet 'tis necessary they be here repeated with a particular View

to the Subject of this Chapter.

MELODY is the agreeable Effect of different musical Sounds, successively ranged and disposed; so that Melody is the Effect only of one single Part; and tho it is a Term chiefly applicable to the Treble, as the Treble is mostly to be distinguished by its Air, yet in so far as the Bass may be made airy, and to sing well, it may be also properly said to be melodious.

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HARMONY is the agreeable Refult of the Union of Two or more mufical Sounds heard at one and the same Time; so that Harmony is the Effect of TwoParts at least: As therefore; a continued Succession of musical Sounds produces Melody, fo does a continued Combination of

these produce Harmony.

OF the Twelve Intervals of musical Sounds, known by the Names of Second leffer, Second greater, Third leser, Third greater, Fourth, false Fifth, (which is called Tritone or Semidiapente in Chap. 8. 6 4.) Fifth, Sixth leffer, Sixth greater, Seventh lesser, Seventh greater and Octave, all Melody and Harmony is composed; for the Octaves of each of these are but Replications of the fame Sounds; and whatever therefore is or shall be faid of any or of all of these Sounds, is to be understood and meant as faid also of their Octaves.

THESE Intervals, as they are expressed by Notes, stand, as in Example 1. C being the fundamental Note from which the rest receive their Denominations: Or they may stand as in the Second Example, where g is the fundamental Note; for whatever be the Fundamental, the Distances of Sound are to it, and reciprocally to

each other the same.

Of these Intervals Two, viz. the Octave and Fifth, are called perfect Concords: Four, viz. the Two 3ds and Two 6ths, are called imperfect Concords: Five viz. the false Fifth, the Two Seconds and Two Sevenths, are Discords. The Fourth is in its own Nature a perfect Con-

the 3d and the 5th, it can never be made use of as a Concord, but when joined with the 6th with which it stands reciprocally in the Relation of a 3d; it is therefore commonly classed among the Discords, not on account of the Nature of the Interval, but because of its little Use in the Harmony of Concords.

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2. Of the principal Tone or Key.

THE Key in every Piece and in every Part of each Piece of musical Composition is that Tone or Sound which is predominant and to which all the rest do refer (See above Chap. 9.)

EVER Plece of Musick, as a Concerto, Sonata or Cantata is framed with due regard to one particular Sound called the Key, and in which the Piece is made to begin and end; but in the Course of the Harmony of any such Piece, the Variety which in Musick is so necessary to please and entertain, requires the introducing of several other Keys.

It is enough here to consider, that every the least Portion of any Piece of Musick has its Key; which rightly to comprehend we are to take Notice, that a well tuned Voice, tho' unaccustomed to Musick, ascending by Degrees from any Sound assigned, will naturally proceed from such Sound to the 2d g. from thence to the

the 3d l. or to the 3d g. indifferently from either of these to the 4th, from thence to the 5th, from thence to the 6th l. or 6th g. accordingly as it has before either touched at the 3d l. or 3d g. from either of these to the 7th g. and from thence into the Octave: From which it is inferred, that of the 12 Intervals within the Compass of the Octave of any Sound assigned, seven are only natural and melodious to that Sound, viz. the 2d g. 3d g. 4th, 5th, 6th g. 7th g. and 8ve, if the proceeding be by the 3d g. but if it is by the 3d l. the Seven natural Sounds are the 2d g. 3d l. 4th, 5th, 6th l. 7th g. and 8ve, as they are express'd in the Examples, 3d and 4th.

As therefore the 3d and 6th may be either greater or lesser, from thence it is that the Key is denominated sharp or flat; the sharp Key being distinguished by the 3d g. and the Flat by

the 3dl.

In such a Progression of Sounds, the fundamental one to which the others do refer, is the principal Tone or Key; and as here C is the Key, so may any other Note be the Key, by being made the fundamental Note to such like Progression of Notes, as is already exemplified.

WHATEVER be the Key, none but the Seven natural Notes can enter into the Composition of its Harmony: The Five other Notes that are within the Compass of the Octave of the Key, viz. the 2d l. 3d l. salse 5th, 6th l.

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7th l. in a sharp Key; and the 2d l. 3d g. false 5th, 6th g. and 7th l. in a flat one, are always extra-

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WHEN these Seven Notes shall happen to be mentioned in the Bass as Notes, I shall for Distinction's fake express them by the Names of 2d. Fundamental or 2df. 3df. 4thf. 5thf. 6thf. 7th f. the Octave being a Replication of the Key, will need no other Name than the Key f. But when any of the Octaves of these Seven Notes shall happen to be mentioned as Ingredients of the Treble, I shall describe them by the simple Names of 2d, 3d, 4th, 5th, &c. Thus, when the 3d f. or its Octave, which is the same Thing, shall happen to be considered as a Treble Note, it is to be marked simply thus (3d) as being a Third to the Key Fund. Thus the 5th f. or its Octave, when confidered as a Note in the Treble, is to be simply marked thus (5th) as being a 5th to the Key f: Or thus (3d) as being a 3d to the 3d f: Or thus (6th) as being a 6th to the 7th f. and fo of the rest.

EACH of the Seven natural Notes therefore in each Key, considered as fundamental, or as Notes of the Bass, have their respective 3ds 5ths, 6ths, &c. which respective 3ds, 5ths, 6ths, &c. must be some one, or Octaves to some one or other of the 7 fundamental Notes that are natural to the Key; because, as was said before, nothing can enter into the Harmony of any Key, but its Seven natural Notes and their O-

ctaves.

3. Of Composition.

UNDER this Title of Composition are justly comprehended the practical Rules. 1mo. Of Melody, or the Art of making a fingle Part, i. e. contriving and disposing the fingle Sounds, fo that their Succession and Progress may be agreeable; and 2do. Of Harmony, or the Art of disposing and conserting several single Parts so together, that they may make one agreeable Whole. And here observe, the Word Harmony is taken somewhat larger than above in Chap. 7. for Discords are used with Concords in the Composition of Parts, which is here exprest in general by the Word Harmony; which therefore is distinguished into the Harmony of Concords in which no Discords are used, and that of Discords which are always mixt with Concords. Objerve also that this Art of Harmony has been long known by the Name of Counterpoint; which arose from this, That in the Times when Parts were first introduced, their Mufick being so simple that they used no Notes of different Time, that Difference depending upon the Quantity of Syllables of the Words of a Song, they marked their Concords by Points set against one another. And as there were no different Notes of Time, fo the Parts were in every Note made Concord: And this afterwards was called simple or plain Counterpoint, to distinguish it from another Kind, wherein Notes of different Value were used, and Discords brought Dd 2

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in betwixt the Parts, which was called figu-

rate Counterpoint.

OBSERVE again, Melody is chiefly the Business of the Imagination; so that the Rules of Melody serve only to prescribe certain Limits to it, beyond which the Imagination, in searching out the Variety and Beauty of Air, ought not to carry us: But Harmony is the Work of Judgment; so that its Rules are more certain, extensive, and in Practice more difficult. In the Variety and Elegancy of the Melody, the Invention labours a great deal more than the Judgment; but in Harmony the Invention has nothing to do, for by an exact Observation of the Rules of Harmony it may be produced without that Assistance from the Imagination.

It may not be impertinent here to observe, that it is the great Business of a Composer not to be so much attach'd to the Beauty of Air, as to neglect the solid Charms of Harmony; nor so servilly subjected to the more minute Niceties of Harmony, as to detract from the Melody; but, by a just Medium, to make his Piece conspicuous, by preserving the united Beauty both of Air and Harmony.

1 2. Rules of Melody.

I. A NY Note being chosen for the Key, and its Quality of sharp or flat determined, no Notes must be used in any Part but the natural

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tural and effential Notes of the Key, as these are already shewn: And for changing or modulating from one Key to another, which may also be done, you'll find Rules below in 0.5.

II. Concerning the Succession of Intervals in the feveral Parts, you have these general.

Rules.

1. THE Treble ought to proceed by as little Intervals, as is possibly consistent with that Variety of Air, which is its distinguishing Character.

2. THE Bass may proceed either gradually or by larger Intervals, at the Will of the Com-

pofer.

3. THE ascending by the Distance of a false 5th is forbid, as being harsh and disagreeable; but descending by such a Distance is often

practifed especially in the Bass.

4. To proceed by the Distance of a spurious 2d, that is, from any Note that is *, to the Note immediately above or below it that is 1; or from any Note 1 to the Note immediately above or below it *, is very offensive. As we are in greatest Danger of transgressing this Rule in a flat Key, because of the 6th l. and 7th g. which are Two of the natural Notes of the Harmony, we are therefore to take Care, that descending from the Key we may proceed by the 7th 1. to the 6th 1. and afcending to it we may proceed by the 6th g. to the 7th g. For altho'the 6th g. and 7th 1. are not of the Seven Notes of

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a flat Key, yet they may be thus made Use of as Transitions, without any Offence.

5. The proceeding by the Distance of a 7th

1. in any of the Parts, is very harsh.

Thus far may Rules be given to correct the Irregularities of Invention in point of Air; but to acquire or improve it, nothing less is necessary than to be acquainted with the Melody of the more celebrated Composers, so as to have the more ordinary, and, as it were, common Places of their Melody, familiar to the Ear; and what is further necessary will, in due Time, naturally follow a Genius turned that Way.

§ 3. Of the Harmony of Concords, or simple Counterpoint.

THE Harmony of Concords is composed of the imperfect, as well as of the perfect Concords; and therefore may be said to be perfect and imperfect, according as the Concords are of which it is composed; thus the Harmony that arises from a Conjunction of any Note with its 5th and Octave is perfect, but with its 3d and 6th is imperfect.

It has been already shewn what may enter into the *Harmony* of any *Key*, and what may not. I proceed to shew how the Seven natural Notes, and their *Octaves* in any *Key*, may stand together in a *Harmony* of *Concord*; and how

how the feveral Concords may fucceed other; and then make some particular Application, which will finish what is desig d on this Branch.

I. How the Concords may stand together.

on of perfect and imperfect Harmony, take this general Rule, viz. to the Key f. to the 4th f. and to the 5th f. a perfect Harmony must be joyned. To the 2d f. to the 3d f. and to the 7th f. an imperfect Harmony is in all Cales indipensably required. To the 6th f. a perfect or imperfect Harmony is arbitrary.

OBSERVE, In the Composition of Two Parts, tho' a 3d appears only in the Treble upon the Key f. the 4th f. and the 5th f. yet the perfect Harmony of the 5th is always supposed, and must be supplied in the Accompanyments of the thorough Bass to these fundamen-

tal Notes.

2. But more particularly in the Composition of Two Parts.

The RULES are,

1. THE Key f. may have either its Octave,

its 3d or its 5th.

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2. The 4th f. and 5th f. may have either their respective 3ds or 5ths; and the sirst may have its 6th; as, to savour a contrary Motion, the last may have its Octave.

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3. THE

3. THE 6th f. may have either its 3d, its

5th or its 6th.

4. THE 2df. 3df. and 7thf. may have either their respective 3ds or 6ths; and the last may, on many Occasions, have its false 5th.

THESE Rules are still the same whether the the Key is sharp or flat, as they are exemplified

in Example 5, 6, 7, 8, 9, 10, 11.

AFTER having considered what are the several Concords, that may be harmoniously applied to the seven fundamental Notes; it is next to be learned, how these several Concords may succeed each other, for therein lies the greatest Difficulty of musical Composition.

II. The general Rules of Harmony, respecting

the Succession of Concords.

proceed by a contrary Movement, that is, when the Bass ascends, the Treble may at the same Time descend, & vice versa; but as it is impossible this can always be done, the Rule only prescribes the doing so as frequently as can be, Exam. 12.

2. The Parts moving the same Way either upwards or downwards, Two Octaves or Two 5ths must never follow one another immediate-

ly, Exam. 13.

3. Two 6ths l, must never succeed each other immediately; the Danger of transgressing which lies chiefly in a sharp Key, where the 6th to the 6th f, and to the 7th f, are both lesser, Exam, 14.

4. WHENEVER

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4. Whenever the Octave or 5th is to be made use of, the Parts must proceed by a contrary Movement to each other; except the Treble move into such Octave or 5th gradually; which Rule must be carefully observed, because the Occasions of transgressing it do most frequently occur, Ex. 15.

5. If in a sharp Key, the Bass descends gradually from the 5th f. to the 4th f; the last must never in that Case have its proper Harmony applied to it, but the Notes that were Harmony

the 4th f. Exam. 16.
6. THIRDS and 6ths may follow one another immediately, as often as one has a Mind.

to the preceeding 5th f. must be continued upon

Exam. 17.

HERE then are the Rules of Harmony plainly exhibited, which tho' few in Number, yet the Beginner will find the Observance of them a little difficult, because Occasions of transgref-

fing do most frequently offer themselves.

In the former Article it is shewn what Concords may be applied to each Fundamental or Bass-note; and here is taught how the Parts may proceed joyntly, the Section 2d shewing how they may proceed singly, and what in either Case is to be avoided. It remains therefore now to make the Application.

III. A particular Application of the preceeding. Rules, to two Parts.

WMEREAS it is natural to Beginners, first to imagine the Treble, and then to make a Rass

RULES for making a Bass to a Treble, in the sharp as well as flat Key.

Practice of fingle Counterpoint.

1. THE Key may have for its Bass, either the Key f. the 4th f. to which it is a 5th, the 3d f. to which it is a 6th, or the 6th f. to which it is a 3d.

2. THE 2d may have for its Bafs, either the 7th f. to which it is a 3d, or the 5th f. to which is is a 5th, and sometimes the 4th f. to which

it is a 6th.

3. THE 3d can rarely have any other Bass but the Key f. tho' fometimes it may have the

6th f. to which it is a 5th.

4. THE 4th may have for its Bass either the 2df. to which it is a 3d, or the 6th f. to which it is a 6th, and sometimes, to savour a contrary Movement of the Parts, it may have the 7th f. to which it is a salse 5th, which ought to resolve in the 3d, the Bass ascending

to the Key, and the Treble descending to the

3d.

5. THE 5th may have for its Bass, either the 3df. to which it is a 3d, the Key to which it is a 5th, the 7th f. to which it is a 6th; or, sometimes, to savour a contrary Movement of the Parts, it may have the 5th f. to which it is an Octave.

6. THE 6th may only have for its Bass the

4th f. to which it is a 3d.

7. THE 7th may have for its Bass, either the 5th f. to which it is a 3d, or the 2d f. to which it is a 6th.

I have carefully avoided the mentioning the 3ds and 6ths, particularly as they are greater or lesser, which would inevitably puzzle a Beginner: According to the Plan I have followed, there is no need to be fo particular, because when a 3d and 6th are mentioned here in general, one is always to understand such a 3d and fuch a 6th as makes one of the Seven natural Notes of the Key; thus when I fay that in a sharp Key the 5th is a 3d, to the 3d f. I must necessarily mean that it is a 3d l. to it, because the 3d g. to the 3d f. is one of the Five extraneous Notes; just so when I say that in a flat Key the 5th is a 3d to the 3d f. I must needs mean that it is a 3dg. to it, because the 3dl. to it is one of the Five extraneous Notes: Thus when I say that the 3d f. in either Key may have a 3d or a 6th for its Treble Note, it must be understood as if I faid that fuch 3d and 6th in to it, the Treble being the shining Part, in which the Beauty of Melody is chiefly to appear; in Compliance therewith, I shall, by inverting as it were the Rules in the foregoing Section, set forth, in the following Rules, which of the Seven fundamental Notes, in the sharp and flat Keys, can properly be made use of to each of the Seven natural Notes that may enter into the Treble; of which an exact Remembrance will very much facilitate the attaining a Readiness in the Practice of single Counterpoint.

RULES for making a Bass to a Treble, in the sharp as well as flat Key.

1. THE Key may have for its Bass, either the Key f. the 4th f. to which it is a 5th, the 3d f. to which it is a 6th, or the 6th f. to which it is a 3d.

2. THE 2d may have for its Bass, either the 7th f. to which it is a 3d, or the 5th f. to which is is a 5th, and sometimes the 4th f. to which

it is a 6th.

3. THE 3d can rarely have any other Bass but the Key f. tho' fometimes it may have the

6th f. to which it is a 5th.

4. THE 4th may have for its Bass either the 2df. to which it is a 3d, or the 6th f. to which it is a 6th, and sometimes, to favour a contrary Movement of the Parts, it may have the 7th f. to which it is a salse 5th, which ought to resolve in the 3d, the Bass ascending

to the Key, and the Treble descending to the 3d.

5. THE 5th may have for its Bass, either the 3d f. to which it is a 3d, the Key to which it is a 5th, the 7th f. to which it is a 6th; or, sometimes, to savour a contrary Movement of the Parts, it may have the 5th f. to which it is an Octave.

6. THE 6th may only have for its Bass the

4th f. to which it is a 3d.

7. THE 7th may have for its Bass, either the 5th f. to which it is a 3d, or the 2d f. to which it is a 6th.

I have carefully avoided the mentioning the 3ds and 6ths, particularly as they are leser, which would inevitably greater or puzzle a Beginner: According to the Plan I have followed, there is no need to be fo particular, because when a 3d and 6th are mentioned here in general, one is always to understand such a 3d and fuch a 6th as makes one of the Seven natural Notes of the Key; thus when I fay that in a sharp Key the 5th is a 3d, to the 3d f. I must necessarily mean that it is a 3d l. to it, because the 3d g. to the 3d f. is one of the Five extraneous Notes; just so when I say that in a flat Key the 5th is a 3d to the 3d f. I must needs mean that it is a 3dg. to it, because the 3dl. to it is one of the Five extraneous Notes: Thus when I say that the 3d f. in either Key may have a 3d or a 6th for its Treble Note, it must be understood as if I faid that fuch 3d and 6th in

a sharp Key must be both lesser, and in a flat Key, they must be both greater, because in the first or sharp Key the 3d g. and 6th g. of the 3d f. are extraneous, and so are the 3d l. and the 6th l. of the 3d f. in a flat Key: But considering how much it would embarass and multiply the Rules, to have characterized the 3ds and 6ths so particularly, I have therefore contrived the Plan I proceed upon, so as to avoid both these Inconveniencies, and by being general make the same Rules rightly understood, serve both for a sharp and a flat Key.

But now that the Contents of the foregoing Rules may be the more easily committed to the Memory, I shall therefore convert them into this Scheme, where the Asterism is intended to de-

note what is but used sometimes.

Scheme drawn from the preceeding Rules.

| sof the 7th | in the | 3d, 6th. | e | 3J.AJ.7[.5]. 4f. 5f.2f. |
|-------------|---------|-----------------|---|---------------------------------|
| S | ee this | exemplified, Ex | | |

These Rules being well understood, and exactly committed to the Memory, the Treble in Ex. 19. is supposed to be assign'd, and the Bass composed to it according to these and the former Rules.

THE first Thing I am to observe in the Treble is, that its Key is c natural, i. e. with the 3d g. because it begins and ends in c without touching any Note but the Seven that be-

long to the Harmony of that Key.

The second Note in the Treble is the second in the Harmony of the Key; which, according to the Rules, might have stood as a 3d to the Bass, as well as a 5th; to which therefore the Bass might have been b, as well as g. but I rather chused the latter, because having begun pretty high with the Bass, I foresaw I should want to get down to c below, for a Bass to the 3d Note in the Treble; and therefore I chused g here rather than b, being a more natural and melodious Transition to c below.

THE third Note in the Treble, and 3d in the Harmony of the Key, has c the Key f. for its Bass, because it is almost the only Bass it can have: And I chused to take the Key below for the Reason I just now mentioned.

THE fourth Note in the Treble and 4th in the Harmony of the Key, has the 2df. for its Bass, which here is d; it is capable of having for its Bass the 6th f. but considering what behoved to follow, it would not have been so natural.

THE fifth Note in the Treble and 5th in the Harmony of the Key, has for its Bass the 3d f. which is here e. it might have had c the Key for its Bass, and the going to f afterwards would have sung as well; but I chused to ascend gradually

gradually with the Bass, to preserve an Imitation that happens to be between the Parts, by the Bass ascending gradually to the 5th f. from the Beginning of the second Bar, as the Treble does from the Beginning of the first Bar.

THE fixth Note in the Treble, and Key in the Harmony, stands as a 5th; and has for its Bass the 4th f. rather than any other it might have had, for the Reason just now mentio-

ned.

THE feventh Note in the Treble, and 7th in the Harmony of the Key, has the 5th f. rather than the 2d f. for its Bass, not only on account of the Imitation I took Notice of, but to favour the contrary Movement of the Parts; and besides, considering what behoved to sollow in the Bass, the 2df. would not have done so well here; and the Transition from it to the Bass Note that must necessarily follow, would not have been fo natural. As to the following Notes of the Bass I need say nothing; for the Choice of them will appear to be from one of thefe Two Confiderations, either that they are the only proper Bass Notes that the Treble could admit of, or that one is chosen rather than another to favour the contrary Movement of the Parts.

I chused rather to be particular in setting forth one *Example* than to perplex the Beginner with a Multitude of them; I have therefore only added a second, which I refer to the Student's own Examination; both which are so contrived, as to be capable of being transposed

in

WHEN these Examples are thoroughly examined, the next Step I would advise the Beginner to make, would be to transpose these Trebles into other Keys; and then endeavour to make a Bass to them in these other Keys: For to him, the same Treble in different Keys will be in some Measure like so many different Trebles, and will be equally conducive to his Improvement. And when he has finished the Bass in these other Keys, let him cast his Eyes on the Example, and transpose the Bass here into the same Keys, that he may observe wherein they differ, and in what they agree; by which Comparison he will be able to discover his Faults, and become a Master to himself. And by the 'Time that he can with Facility write a Bass to these Two Trebles, in all the usual Keys, which upon Examination he shall find to coincide with the Examples, I may venture to affure him that he has conquered the greatest Difficulty.

NOTWITHSTANDING the infinite Variety of Air there may be in Musick, I take it for granted, that there are a great many common Places in point of Air, equally familiar to all Composers, which necessarily produce correspondent common Places in Harmony; thus it most frequently happens that the Treble descends from the 3d to the Key, as at the Example 20, as often will the Treble descend from

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the 7th to the 5th. Examples 21, 22, and in this Case the Bass is always the 5 f. as in that the Bass is always the Key f. Thus frequently in the Treble, after a Series of Notes the Air will terminate and come to a Kind of Rest or Close upon the 2d or 7th; in both which the Bass must always be the 5th f. as in Examples 23, 24. Some other common Places will appear sufficiently in the Examples, and others, for the Beginner's Instruction, he will best gather himself from the Works of Authors, particularly of Corelli.

As a thorough Acquaintance with such common Places, will be a great Assistance to the Beginner, I would first recommend to him the Practice of those here set forth, in all the usual Keys sharp as well as flat, till they are become very samiliar to him: But in transposing them to flat Keys, the Variation of the 3d and 6th is

to be carefully adverted to.

AFTER simple Counterpoint, wherein nothing but Concords have Place, the next Step is to that Counterpoint wherein there is a Mixture of Discord; of which there are Two Kinds, that wherein the Discords are introduced occasionally to serve only as Transitions from Concord to Concord, or that wherein the Discord bears a chief Part in the Harmony.

- 1 4. Of the Use of Discords, or Figurate Counterpoint.
- 1. Of the transient Discords that are subservient to the Air, but make no Part of the Harmony.

EVERY Bar or Measure has its accented and unaccented Parts: The Reginning and Middle, or the Reginning of the first Half of the Bar, and Beginning of the latter Half thereof in common Time; and the Beginning, or the first of the Three Notes in triple Time, are always the accented Parts of the Measure. So that in common Time the first and third Crotchet of the Bar, or if the Time be very flow, the 1st, 3d, 5th and 7th Quavers are on the accented Parts of the Measure, the rest are upon the unaccented Parts of it. In the various Kinds of Triple whether 11 3 or 1 the Notes go always Three and Three, and that which is in the Middle of every Three is always unaccented, the first and last accented; but the Accent on the first is fo much stronger, that, in feveral Cases, the last is accounted as if it had no Accent; so that a Difford duly prepared never ought to come upon it.

THE Harmony must always be full upon the accented Parts of the Measure, but upon the unaccented Parts that is not so requisite: Wherefore Discords may transiently pass there without E e

out any Offence to the Ear: This the French call Supposition, because the transient Discord supposes a Concord immediately to follow it, which is of infinite Service in Musick, as contributing mightily to that infinite Variety of Air of which Musick is capable.

OF SUPPOSITION there are several Kinds. The first Kind is when the Parts proceed gradually from Concord to Discord, and from Discord to Concord as in the Examples 25 and 26. where the intervening Discord serves only as a Transition to the following Concord.

By imagining all the Crotchets in the Treble to be Minims, and all the Semibreves in the Bass of the Example 25. to be pointed, it will serve as an Example of this Kind of Supposition in

triple Time.

THERE is another Kind, when the Parts do not proceed gradually from the Discord to the Concord, but descend to it by the Distance of a 3d. as in the Examples 27 and 28. where the Discord is esteem'd as a Part of the preceding Concord.

THERE is a third Kind refembling the fecond, when the rising to the Discord is gradual, but the descending from it to the following Concord is by the Distance of a 4th, as in Example 29. in which the Discord is also considered as a Part. or Breaking of the preceeding Concord.

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THERE is a fourth Kind very different from the Three former, when the Discord falls upon the accented Parts of the Measure, and when the rising to it is by the Distance of a 4th; but then it is absolutely necessary to follow it immediately by a gradual Descent into a Concord that has just been heard before the Harmony, by which the Discord that preceeds gives no Offence to the Ear, serving only as a Transition into the Concord, as in Example 30.

Thus far was necessary to be taught by way of Institution upon the Subject of Suprosition; what further Liberties may be taken that Way in making Divisions upon holding Notes, as in Example 31 may be easily gathered from what has been said; observing this as a Principle never to be departed from, that the less one deviates from the Rules, for the sake of

Air, the better.

2. Of the HARMONY of DISCORDS.

THE Harmony of Discords is, that wherein the Discords are made use of as a solid and substantial Part of the Harmony; for by a proper Interposition of a Discord the succeeding Concords receive an additional Lustre. Thus the Discords are in Musick what the strong Shades are in Painting; for as the Lights there, so the Concords here, appear infinitely more beautiful by the Opposition.

THE DISCORDS are 1 mo. the 5th when joyn'd with the 6th, to which it stands in relation as

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2 Discord, and is therefore treated as a Discord in that Place; not as it is a 5th to the Bass in which View it is a perfect Concord, but as being joyn'd with the Note immediately above it, there arises from thence a Sensation of Discord.

Concord to the Bass, yet being joyn'd with the 5th, which is immediately above it, is also used

as a Discord in that Cafe.

3tia. THE Ninth which is in effect the 2d, and is only called the Ninth to distinguish it from the 2d, which under that Denomination is used in a different Manner, is in its own Nature a Discord.

4to. THE 7th is in its own Nature a Dif-

cord.

the Bass syncopates, in a very different Manner from that of using those above mentioned,

as will appear in the Examples.

As I treat only of Composition in Two Parts, there is no Occasion to name the Concords with which, in Composition of Three or more Parts, the Discords are accompanied; these, I take for granted, are known to the Performer of the thorough Bass; and the in Composition of Two Parts they cannot appear, yet they are always supposed and supplied by the Accompanyments of the Bass.

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Of Preparation and Resolution of Discords.

THE Discords here treated of are introduced into the Harmony with due Preparation; and they must be succeeded by Concords, commonly called the Resolution of the Discord.

THE Discord is prepared, by sublisting first in the Harmony in the Quality of a Concord, that is, the same Note which becomes the Discord is first a Concord to the Bass Note immediately preceeding that to which it is a Discord; the Discord is resolved, by being immediately succeeded by a Concord descending from it by the Distance only of 2d g. or 2d l.

As the Discord makes a substantial Part of the Harmony, so it must always possels an accented Part of the Measure: So that in common Time it must fall upon the ist and 3d Crotchet; or, if the Time be extremely slow, upon the ist, 3d, 5th or 7th Quaver of the Bar; and in triple Time it must fall on the first of every Three Crotchets, or of every Three Minims, or of every Three Quavers, according as the triple Time is, there being various Kinds of it.

In order then to know how the Discords may be properly introduced into the Harmony, I shall examine what Concords may serve for their Preparation and Resolution; that is, Whether the Concords going before and following such and such a Discord may be a 5th, 6th, 3d or Octave.

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A TREATISE CHAP. XIII.

Tue 5th may be prepared, by being either an 80e, 6th or 3d; it may be refolved either into the 6th or 3d, but most commonly into the 3d. Example 32.

THE 4th may be prepared in all the Concords; and may be refolved into the 6th, 3d or 8ve, but most commonly into the 3d. Exam-

ple 33.

THE 9th may be prepared in all the Concords except the 8ve, and may be refolved into the 6th, 3d or 8ve, but most commonly into the 8ve. Example 34.

THE 7th may be prepared in all the Concords; and may be refolved into the 3d, 6th or 5th, but most commonly into the 6th or 3d.

Example 35.

THE 2d and 4th are made use of after a quite different Manner from the other Discords, being prepared and resolved in the Bass. Thus, when the Bass descends by the Distance of a 2d, and the first Half of the Note falls upon an unaccented Part of the Measure, then either the 4th or the 2d may be applied to the last or accented Half of the Note; if the 2d, it is continued upon the following Note in the Bass, and becomes the 3d to it; if the 4th is applied, the Treble rifes a Note, and becomes a 6th to the Bals. Example 36.

FROM all which I must observe, that the 5th and 7th are Discords of great Use, because, even in Two Parts, they may be made use of fuccessively for a pretty long Series of Notes without Interruption, especially the 7th, as pro-

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ducing a most beautiful Harmony. The 4th is not useful in Two Parts in this successive Way, but is otherwise very useful. The 9th in the same Manner is only useful as the 4th is.

HAVING once distinctly understood how the Discords are introduced and made a Part of the Harmony, by the Examples that I have exhibited in plain Notes, it may not be amifs to take a View, in the Examples here fet forth, how these plain Notes may be broke into Notes of less Value; and being so divided, how they may be disposed to produce a Variety of Air: Which Examples may suffice to give the Beginner an Idea how the Discords may be divided into Notes of small Value, for the fake of Air. Of the Manner of doing it there is an infinite Variety, and therefore to have shewn all the possible Ways how it may be done, would have required an infinite Number of Examples: I shall therefore only give one Caution, that in all fuch Breakings the first Part of the discording Note must distinctly appear, and after the remaining Part of it has been broke into a Division of Notes of less Value, according to the Fancy of the Composer, such Division ought to lead naturally into the refolving Concord that it may be also distinctly heard. See Example 37.

HAVING now confidered the Matter of Harmony as particularly as is necessary to do by way of Institution, to qualify the Student for reading and receiving Instruction from the E e 4 Works Add A TREATISE CHAP, XIII.

Works of the more celebrated Composers, which is the utmost that any Treatise in my Opinion ought to aim at, I proceed to describe the Nature of Modulation, and to give the Rules for guiding the Beginner in the Practice of it.

§ 5. Of MODULATION; and

Imo, What it is.

ALTHO' every Piece of Musick has one particular Key wherein it not only begins and ends, but which prevails more through the whole Piece; yet the Variety that is so necessary to the Beauty of Musick requires the frequent changing of the Harmony into several other Keys; on Condition always that it return again into the Key appropriated to the Piece, and terminate often there by middle as well as final Cadences, especially if the Piece be of any Length, else the middle Cadences in the Key are not so necessary.

These other Keys, whether sharp or flat into which the Harmony may be changed, must be such whose Harmonies are not remote to the Harmony of the principal Key of the Piece; because otherwise the Transitions from the principal Key to those other intermediate ones, would be unnatural and inconsistent with that

Analo-

Analogy which ought to be preserved between all the Members of the same Pièce. Under the Term of Modulation may be comprehended the regular Progression of the several Parts thro the Sounds that are in the Harmony of any particular Key as well as the proceeding naturally and regularly with the Harmony from one Key to another: The Rules of Modulation therefore in that Sense are the Rules of Melody and Harmony, of which I have already treated; so that the Rules of Modulation only in this last

Sense is my present Business.

SINCE every Piece must have one principal Key, and fince the Variety that is so necessary in Musick to please and entertain, forbids the being confin'd to one Key, and that therefore it is not only allowable but requisite to modulate into and make Cadences upon feveral other Keys, having a Relation and Connection with the principal Key, I am first to consider what it is that constitutes a Connection between the Harmony of one Key and that of another, that from thence it may appear into what Keys the Harmony may be led with Propriety: And in order to comprehend the better wherein this Connection between the Harmony of different Keys may confift, I shall first shew what it is that occations an Inconsistency between the Harmony of one Key and that of another.

2. Of the Relation and Connection of Keys.

It has been already fet forth, that each Key has Seven Notes belonging to it and no more.

In a harp Key these are fix'd and unalterable: but in a flat Key there is one that varies, viz. the 7th. Hitherto I have accounted the 7thg. one of the Seven natural Notes in a flat Key, and I behoved to do fo in the Matter of Harmony, because the 7th g. is the 3d g. to the 5th, without the Help of which there would be no Cadence on the Key; and besides, it is alone by the Help of it that one can ascend into the Key. But here when I consider not the particular Exigencies of the Harmony in a flat Key, but the general Analogy there is between the Harmony of one Key and that of another, I must reckon that the 7th which is effential in a flat Key is the 7th l. because both the 3d and 6th in a flat Key are lesser, therefore as to our present Enquiry the 7th g. in a flat Key must be hence. forth accounted extraneous.

The distinguishing Note in each Key, next to the Key-note it self, is the 3d; any Key therefore that has for its 3d any one of the Five extraneous Notes of another Key, under what Denomination soever of * or * t is discrepant with that other Key to which such 3d is extraneous. Thus the extraneous Notes of the sharp Key c being c*, d*, f*, g*, a*, or as the same Notes may happen to be differently denominated d*, e*, g*, a*, or as the same Notes may happen to be differently denominated d*, e*, g*, a*, b having d* for its 3d, the sharp Key b having d* for its 3d, the sharp Key e having g* for its 3d, the sharp Key f* having a* for its 3d, or the sharp Key f* having d* for its 3d, the sharp Key e* having g* having e* for its 3d, the sharp Key e* having g*

for its 3d, the flat Key f having at for its 3d, and the flat Key g having I for its 3d, are all, I fay, discrepant with the sharp Key c, because the 3ds which are the distinguishing Notes of these other Keys are all extraneous Notes to c, with a 3dg. and fince any Key which has for its 3d any one of the Five extraneous Notes of another Key, is discrepant with that other Key, a fortiori therefore any one of the Five extraneous Notes of a Key being a Key it felf, is utrerly discrepant with a Key, to which such Kynote it felf is extraneous; thus therefore cx, dx, fx, gx, ax, or, dv, ev, gv, av, being considered as Reys, whether with 3dg. or 3dl. are utterly discrepant to c with a 3dg. because they are all

extraneous to it.

A Key then being affign'd as a principal Key, as none of its five extraneous Notes can either be Keys themselves, or 3ds to Keys that can have any Connexion with it, fo it will from thence follow, that the Seven natural Notes of the Key affigned, being constituted Keys with fuch 3ds as are one or other of the Seven natural Notes of the faid Key affign'd, may be accounted confonant to it; provided they do not essentially introduce the principal Key or its 3d under a new Denomination, that is, the Key assign'd being for Example the Sharp Key c, no Key can be confonant to it, that introduces neceffarily and effentially c*, which is the Key under a new Denomination, or ex, which is its 3d under a new Denomination, and different from what they were in the Key assign'd; therefore 444 A TREATISE CHAP. XIII.

fore to the sharp Key c, which I shall take for the principal Key assign'd, the flat Keys d, e and a, also the sharp Keys f and g are consonant; but the flat Key b, altho' both it felf and its ad are Two of the Seven natural Notes of the Key affigned, is not confonant to it, because it would essentially introduce cox for its 2d, which being the Key assign'd under a new Denomination, would produce a very great Inconfiftency with it. And here, left from thence the Beginner may form this Objection against the flat Key d. being reckoned confonant to the lbarb Keyc. as I have done, because that Key d does introduce cx for its 7thg. I must inform him, as I have before observed, that the 7th g. to a flat Key is only occasionally made Use of; and that the 7th 1. is the 7th that is effential in a flat Kev.

The flat Key & being the principal flat Key aligned, the flat Keys f and g, also the flat Keys f and g, also the flat Keys e, at and t are consonant to it, but the flat Key d, tho' both it self and its 3d are of the natural Notes of the Key assigned, yet as this flat Key d being constituted a Key, behoved to have e for its Second, which is the 3d of the Key assigned, under a different Denomination, therefore it cannot be admitted as a consonant

Key to it.

To the Harmony therefore of a flat principal Key, as well as of a sharp one, there are Five Keys that are conformant, that, with all the Elegandy and Property imaginable, may be introduced in the Course of the Modulation of

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any one Piece of Mufick. To all sharp principal Key's the Five confonant Keys are the 2d, 3d, 4th, 5th and 6th to the principal Key, with their respective 3ds, viz. with the 2d, the 3dl. 3d, 3dl. 4th, 3dg. 5th, 3dg. 6th, 3dl, To all flat principal Keys the Five confonant Keys are the 3d, 4th, 5th, 6th and 7th to the principal Key, with their respective 3ds, viz, with the 3d, the 3dg. 4th, 3dl. 5th, 3dl. 6th, 3dg. 7th, 3dg. each of which confonant Keys, tho' reckoned dependent upon their principal Key with regard to the Structure of the whole Piece, yet with respect to the particular Places where they prevail, they are each of them principal fo long as the Modulation continues in them, and the Rules of Melody and Harmony are the same way to be observed in them as in the principal Key; for all Keys of the same Kind are the same, and this Subordination here discoursed of is only accidental; for no Key in its own Nature is more to be accounted principal than another.

The feveral Keys then that may enter into the Composition of the same Piece being known, it is material next to learn in what Order they may be introduc'd; and herein one must have Recourse to the current Practice of the Masters of Composition; from which, tho' indeed no certain Rules can be gathered, because the Order of introducing the consonant Keys is very much at the Discretion of the Composer, and in the Work of the same Author is often various, yet generally the Order is thus.

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In a sharp principal Key, the first Cadence is upon the principal Key it self often; then sollow in Order Cadences on the 5th, 3d, 6th, 2d, 4th, concluding at last with a Cadence on the principal Key. In a flat principal Key the intermediate Cadences are on the 3d, 5th, 7th, 4th and 6th. Now, whatever Liberty may be taken in varying from this Order, yet the beginning and ending with the principal Key is a Principle never to be departed from; and as far as I have observed, it ought to be a Rule also, that in a sharp principal Key, the 5th, and in a flat one the 3d, ought to have the next Place to the principal Key.

3tio. How the Modulation is to be perfor-

med.

IT now remains to shew, how to modulate from one Key to another, fo that the Transitions may be eafy and natural; but how to teach this Kind of Modulation by Rules is the Difficulty; for altho' it is chiefly performed by the Help of the 7th g. of the Key into which we are resolved to change the Harmony, whether it be Sharp or flat; yet the Manner of doing it is fo various and extensive, as no Rules can circumscribe: Wherefore in this Matter, as well as in other Branches of my Subject, I must think it enough to explain the Nature of the Thing fo, and to give the Beginner fuch general Notions of it, as he may be able to gather by his own Observation, in the Course of his Studies of this Kind, what no Rules can teach.

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THE 7th g. in either sharp or flat Key is the 3dg. to the 5thf. of the Key, by which the Cadence in the Key is chiefly perform'd; and by being only a Semitone under the Key, is therefore the most proper Note to lead into it, which it does in the most natural Manner that can be imagin'd; infomuch that the 7th g. is never heard in any of the Parts, but the Ear expects the Key should succeed it; for whether it be used as a 3d or as a 6th, it doth always affect us with fuch an imperfect Sensation, that we naturally expect fomething more perfect to follow, which cannot be more eafily and fmoothly accomplished, than by the small Interval of a Semitone, to pass into the perfect Harmouy of the Key; from hence it is that the Transition into any Key is best effected, by introducing its 7th g. which fo naturally leads to it; and how this 7thg. may be introduced, will best appear in the Examples.

In Ex. 38. the Key is first the sharp Key c, but f*, which is the 7thg. to g, introduces and leads the Harmony into the first consonant Key of c with a 3dg. In this Example f* stands in the Treble a 6th; but it may also stand a 3dg. as in Ex. 39. or it may be introduced into the Bass with its proper Harmony of a 3d or 6th, as in Examples 40 and 42. or it may, as a 6thg. or 3dg. in the Treble, be the resolving Concord of a preceeding Discord, as in Examples 41 and 44. or it may stand in the Treble as a 4thg. accompanied also in that Case with a 2d, or supposed to be so as in Ex.

46.

and 47. The Modulation changes from the sharp Key c into the flat Key a, one of its confonant Keys, whose 7thg. is introduced in the Quality of a 6th g. and 3dg. serving as the Resolutions of preceeding Discords. In Examples 48 and 51. the 6th is applied to the Key, which is always a good Preparation to lead the Harmony out of it; for a Key can be no longer a Key when a 6th is applied. The remaining Examples shew how the Harmony may pass through several Keys in the Compass of a few Notes.

FROM these Examples I shall deduce some few Observations, that may serve as so many Rules to guide the Beginner in this first At-

tempt.

ift. The 7th g. of the Key into which we intend to lead the Harmony, is introduced into the Treble either as a 3dg. or 6th g. or as a 4th g. with its supposed Accompanyments of 4th and 6th; and as 3dg. or 6th g. it is commonly the Resolution of a preceeding Discord.

in what Quality soever, as 3dg. 6thg. &c. it is either succeeded immediately by that Note which is the Key whereto it immediately leads, or immediately preceded by it, and most commonly the last; in which Case the Treble must of consequence descend to it by the Distance of a Semitone. Thus, when we are to change the Harmony from the sharp Key c to the stat Key a, that is, from a sharp principal Key into its

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y ts 6th, we use it in the Treble as the 6th to the principal Key c, or as the 5th to d, or as the 3d to f; and being once upon the Note which we design to be the Key, the falling half a Note to its 7th g. for fixing the Harmony fairly in the Key, is most easily perform'd; thus were we to go from a principal Key into the 3d, we should use a 6th on the 5 f.; or were we to go into the 2d, we should use a 6th on the 4 f. and the rather, because in the Key whereto we design to go, a 6th is the proper Harmony, for that 5th f. of the principal Key becomes the 3df. of the 3d, when it is constitute a Key; and so does the 4th f. of the principal Key becomes the 3df. of the 2d, when it constitute a Key; and so does the 4th f. of the principal Key become the 3df. of the 2d, when constitute a Key.

which we design to change the Harmony, is introduced in the Bass, it is always immediately succeeded by the Key; and then the Transition to the 7thg. is most part gradual, by the Interval of a Tone or Semitone, or by the Interval of a 3dl. But most commonly it is introduced into the Bass, by proceeding to it from the natural Note of the same Name, that is, from a Note that is natural in the Key, as from f to fx in the sharp Key c, or from b to b in the stat Key d.

the sharp Key c, or from v to b in the stat Key d.

4to. When the 7th g. of the Key to which
we design to lead the Harmony, is one of the
Seven natural Notes of the Key wherein the
Harmony already is, the introducing it into the
Bass is most natural, as being of course; this
happens when we would modulate from a sharp
Key into its 4th, or from a stat Key into its

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3d. In which Cases the 7th g. is introduced into the Bass, and in the Treble the false 5th is applied to it, which resolves into the 3dg.

5to. WHEN this 7th g. comes into the Bass, it must of necessity have either a 3dl. 6thl. or false 5th in the Treble; if a 3dl. it resolves into the 8ve, if a 6thl. it commonly passes into the false 5th, and from thence resolves into the 3d of the

Key.

6to. By applying the 6th to any Note of the Key, to which the 5th is a more natural Harmony, as for Example, to the Key it felf, to the 4th f. or 5th f. a Preparation is thereby made for going into another Key, viz. into that Note which is fo made Use of, as a 6th to any of these fundamental Notes, as in the Examples.

HAVING thus explained the Nature of Modulation from one Key to another, it may feem natural to treat now of Cadences; but of these I cannot suppose a Performer of the Thorough-bass ignorant, they being so frequent in Musick; all I shall therefore say of them is, that they must always be finished with an accented Part of the Measure. As to what concerns Fugues and I-mitations I am to say nothing, because these are to be learnt more by a Course of Observation than by Rule. What I proposed was, to set forth the Principles of Composition in Two Parts, by way of Institution only, not daring to proceed any surther than the small Knowledge I have of Musick would lead me with Safety.

CHAP. XIV.

Of the ANCIENT MUSICK.

§ 1. Of the Name, with the various Definitions and Divisions of the Science.

HE Word Musick comes to us from the Latin Word Musica, if not immediately from a Greek Word of the same Sound, from whence the Romans probably took theirs; for they got much of their Learning from the Greeks. Our Criticks teach us, that it comes from the Word Musa, and this from a Greek Word which signifies to search or find out, because the Muses were feigned to be Inventresses of the Sciences, and particularly of Poetry and these Modulations of Sound that constitute Musick. But others go higher, and tell us, the Word Musa comes from a Hebrew Word, which signifies Art or Discipline; hence Musa and Musica anciently fignified Ff2 Learn-

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Learning in general, or any Kind of Science; in which Sense you'll find it frequently in the Works of the ancient Philosophers. But Kircher will have it from an Egyptian Word; because the Restoration of it after the Flood was probably there, by reason of the many Reeds to be found in their Fens, and upon the Banks of the Nile. Helychius tells us, that the Athenians gave the Name of Mulick to every Art. From this it was that the Poets and Mythologifts feigned the nine Muses Daughters of Jupiver, who invented the Sciences, and prefide over them, to affift and inspire these who apply to study them, each having her particular Province. In this geneal Sense we have it defind to be, the orderly Arangement and right Disposition of Things; in short, the Agreement and Harmony of the Whole with its Parts, and of the Parts among themselves. Hermes Trismegistus fays, That Musick is nothing but the Knowledge of the Order of all Things; which was also the Doctrine of the Pythagorean School, and of the Platonicks, who teach that every Thing in the Universe is Musick. Agreeable to this wide Sense, some have diftinguished Musick into Divine and Mundane; the first respects the Order and Harmony that obtains among the Celestial Minds; the other respects the Relations and Order of every other Thing elfe in the Universe. But Plato by the divine Musick understands, that which exists in the divine Mind, viz. these archetypal Ideas of Order and Symmetry, according to which Gob formed all Things; and as this Order exists

exists in the Creatures, it is called Mundane Musick: Which is again subdivided, the remarkable Denominations of which are, First, Elementary or the Harmony of the first Elcments of Things; and these according to the Philosophers, are Fire, Air, Water, and Earth, which tho' feemingly contrary to one another, are, by the Wisdom of the Creator, united and compounded in all the beautiful and regular Forms of Things that fall under our Senses. 2d. Celestial, comprehending the Order and Proportions in the Magnitudes, Distances, and Motions of the heavenly Bodies, and the Harmony of the Sounds proceeding from these Motions: For the Pythagoreans affirmed that they produce the most perfect Confort; the Argument, as Macrobius in his Commentary on Cicero's Somnium Scipionis has it, is to this Purpose, viz. Sound is the Effect of Motion, and fince the heavenly Bodies must be under certain regular and stated Laws of Motion, they must produce fomething musical and concordant; for from random and fortuitous Motions, governed by no certain Measure, can only proceed a grating and unpleasant Noise: And the Reason, fays he, why we are not fenfible of that Sound, is the Vastness of it, which exceeds our Sense of Hearing; in the same Manner as the Inhabitants near the Cataracts of the Nile, are infenfible of their prodigious Noise. But some of the Historians, if I remember right, tell us that by the Excessiveness of the Sounds, these People are rendred quite deaf which makes that Demon-

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Demonstration somewhat doubtful, since we hear every other Sound that reaches to us. Others alledge that the Sounds of the Spheres, being the first we hear when we come into the World, and being habituated to them for a long Time, when we could fcarcely think or make Reflection on any Thing, we become incapable of perceiving them afterwards. But Pythagoras faid he perceived and understood the Celeftial Harmony by a peculiar Favour of that Spirit to whom he owed his Life, as Jamblichus reports of him, who fays, That tho' he never fung or played on any Instrument himself, yet by an inconceivable Sort of Divinity, he taught others to imitate the Celestial Musick of the Spheres, by Instruments and Voice: For according to him, all the Harmony of Sounds here below, is but an Imitation, and that imperfect too, of the other. This Species is by fome called particularly the Mundane Musick. 3d. Human, which confifts chiefly in the Harmony of the Faculties of the human Soul, and its various Passions; and is also considered in the Proportion and Temperament, mutual Dependence and Connection, of all the Parts of this wonderful Machine of our Bodies. 4th. Is what in a more limited and peculiar Sense of the Word was called Musick; which has for its Object Motion, considered as under certain regular Measures and Proportions, by which it affects the Senses in an agreeable Manner. All Motion belongs to Bodies, and Sound is the Effect of Motion, and cannot be without it; but all Motion does not

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not produce Sound, therefore this was again fubdivided. Where the Motion is without Sound, or as it is only the Object of Seeing, it was called Musica Orchestria or Saltatoria, which contains the Rules for the regular Motions of Dancing; also Hypocritica, which respects the Motions and Gestures of the Pantomimes. When Motion is perceived only by the Ear, i. e. when Sound is the Object of Musick, there are Three Species; HARMONICA, which considers the Differences and Proportion of Sounds, with respect to acute and grave; RYTHMICA, which respects the Proportion of Sounds as to Time, or the Swiftness and Slowness of their Successions; and METRICA, which belongs properly to the Poets, and refpects the verfifying Art: But in common Acceptation 'tis now more limited, and we call nothing Musick but what is heard; and even then we make a Variety of Tones necessary to the Being of Musick.

ARISTIDES QUINTILIANUS, who writes a profest Treatise upon Musick, calls it the Knowledge of singing, and of the Things that are joyned with singing (επιςήμη μέλες και τῶν περί μελος συμβαινόντων, which Meibomius translates, Scientia cantus, eorumq; qua circa cantum contingunt) and these he calls the Motions of the Voice and Body, as if the Cantus it self consisted only in the different Tones of the Voice. Bacchius who writes a short Introduction to Musick in Question and Answer, gives the same Definition. Afterwards, Aristides con-

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A.TREATISE CHAP. XIV. 456 fiders Musick in the largest Sense of the Word,

and divides it into Contemplative and Active. The first, he says, is either natural or artificial; the natural is arithmetical, because it considers the Proportion of Numbers, or physical which disputes of every Thing in Nature; the Artificial is divided into Harmonica, Rythmica (comprehending the dumb Motions) and Metrica: The active, which is the Application of the artificial, is either enunciative (as in Oratory,) Organical (or Instrumental Performance,) Odical (for Voice and finging of Poems,) Hypocritical (in the Motions of the Pantomimes.) To what Purpose some add Hydraulical I do not understand, for this is but a Species of the Organical, in which Water is some way used for producing or modifying the Sound. The mufical Faculties, as they call them, are, Melopaia which gives Rules for the Tones of the Voice or Instrument, Rythmopaia for Motions, and Poesis for making of Verse. Again, explaining the Difference of Rythmus and Metrum, he tells us, That Rythmus is applied Thee Ways; either to immoveable Bodies, which are called Eurythmoi, when their Parts are right proportioned to one another, as a well made Statue; or to every Thing that moves, fo we fay a Man walks handsomly (composite,) and under this Dancing will come, and the Business of the Pantomimes; or particularly to the Motion of Sound or the Voice, in which the Rythmus consists of long and short Syllables or Notes, (which he calls Times) joyned together (in Suc-

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Succession) in some kind of Order, so that their Cadence upon the Ear may be agreeable; which constitutes in Oratory what is called a numerous Stile, and when the Tones of the Voice are well chosen 'tis an harmonious Stile. RYTHMUS is perceived either by the Eye or the Ear, and is something general, which may be without Metrum; but this is perceived only by the Ear, and is but a Species of the other, and cannot exist without it: The first is perceived without Sound in Dancing; and when it exists with Sounds it may either be without any Difference of acute and grave, as in a Drum, or with a Varitey of thefe, as in a Song, and then the Harmonica and Rythmica are joyned; and if any Poem is fet to Musick, and fung with a Variety of Tones, we have all the Three Parts of Musick at once. Porphyrius in his Commentaries on Ptolemey's Harmonicks, institutes the Division of Musick another Way; he takes it in the limited Sense, as having Motion both dumb and fonorous for its Object; and, without distinguishing the Speculative and practical, he makes its Parts thefe Six, viz. Harmonica, Rythmica, Metrica, Organica, Poetica, Hypocritica; he applies the Rythmica to Dancing, Metrica to the Enunciative, and Poetica to Verfes.

ALL the other ancient Authors agree in the same threefold Division of Musick into Harmonica, Rythmica and Metrica: Some add the Organica, others omit it, as indeed it is but an accidental Thing to Musick, in what Species of Sounds

Sounds it is exprest. Upon this Division of Musick, the more ancient Writers are very careful in the Inscription or Titles of their Books, and call them only Harmonica, when they confine themselves to that Part, as Aristoxenus, Euclid, Nicomachus, Gaudentius, Ptolomey, Bryennius; but Aristides and Bacchius call theirs Musica, because they profess to treat of all the Parts. The Latines are not always fo accurate, for they inscribe all theirs Musica, as Boethius, tho' he only explains the Harmonica; and St. Augustin, tho' his Six Books de Musica speak only of the Rythmus and Metrum; Martianus Capella has a better Right to the Title, for he makes a Kind of Compend and Translation of Aristides Quintil. tho' a very obscure one of as obscure an Original. Aurelius Cassiodorus needs scarcely be named, for tho' he writes a Book de Musica, 'tis but barely some general Definitions and Divisions of the Science.

THE Harmonica is the Part the Ancients have left us any tolerable Account of, which are at least but very general and Theorical; such as it is I purpose to explain it to you as distinctly as I can; but having thus far settled the Desinition and Division of Musick as delivered by the Ancients, I chuse next to consider histo

rically.

§ 2. The Invention and Antiquity of Musick, with the Excellency of the Art in the various Ends and Uses of it.

OF all human Arts Musick has justest Pretences to the Honour of Antiquity: We scarce need any Authority for this Assertion; the Reason of the Thing demonstrates it, for the Conditions and Circumstances of human Life required some powerful Charm, to bear up the Mind under the Anxiety and Cares that Mankind soon after his Creation became subject to; and the Goodness of our blessed Creator soon discovered it self in the wonderful Relief that Musick affords against the unavoidable Hardships which are annexed to our State of being in this Life; so that Musick must have been as early in the World as the most necessary and indispensable Arts. For

Is we consider how natural to the Mind of Man this kind of Pleasure is, as constant and universal Experience sufficiently proves, we cannot think he was long a Stranger to it. Other Arts were revealed as bare Necessity gave Occasion, and some were afterwards owing to Luxury; but neither Necessity nor Luxury are the Parents of this heavenly Art; to be pleased with it seems to be a Part of our Constitution; but its made so, not as absolutely necessary to our Being, its a Gift of God to us for our more happy and comfortable Being; and therefore we can make no doubt that this Art was among the very first that were known to Men. It is

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reasonable to believe, that as all other Arts, so this was rude and fimple in its Beginning, and by the Industry of Man, prompted by his natural Love of Pleasure, improven by Degrees. If we consider, again, how obvious a Thing Sound is, and how manifold Occasions it gives for Invention, we are not only further confirmed in the Antiquity of this Art, but we can make very threwd Gueffes about the first Discoveries of it. Vocal Musick was certainly the first Kind; Man had not only the various Tones of his own Voice to make his Observations upon, before any other Arts or Instruments were found, but being daily entertained by the various natural Strains of the winged Choirs, how could he not observe them, and from hence take Occasion to improve his own Voice, and the Modulations of Sound, of which it is capable? 'Tis certain that whatever these Singers were capable of, they possest it actually from the Beginning of the World; we are surprised indeed with their fagacious Imitations of human Art in Singing, but we know no Improvements the Species is capable of; and if we suppose that in these Parts where Mankind first appeared, and especially in these first Days, when Things were probably in their greatest Beauty and Perfection, the Singing of Birds was a more remarkable Thing, we shall have less Reason to doubt that they led the Way to Mankind in this charming Art: But this is no new Opinion; of many ancient Authors, who agree in this very just Conjecture, I shall only let you hear Lucretius Lib. 5.

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At liquidas avium voces imitarier ore Ante fuit multo, quam lævia carmina cantu Concelebrare homines possent, aureisque juvare.

THE first Invention of Wind-instruments he ascribes to the Observation of the Whistling of the Winds among the hollow Reeds.

Et Zephyri cava per calamorum sibila primum Agresteis docuere cavas instare cicutas, Inde minutatim dulceis didicere querelas, Tibia quas fundit digitis pulsata canentum.

or they might also take that Hint from some Thing that might happen accidentally to them in their handling of Corn-stalks, or the hollow Stems of other Plants. And other Kinds of Instruments were probably formed by fuch like Accidents: There were fo many Uses for Chords or Strings, that Men could not but very foon observe their various Sounds, which might give Rife to stringed Instruments: And for the pulfatile Instruments, as Drums and Cymbals, they might arise from the Observation of the hollow Noise of concave Bodies. To make this Account of the Invention of Instruments more probable, Kircher bids us consider, That the first Mortals living a pastoral Life, and being constantly in the Fields, near Rivers and among Woods, could not be perpetually idle; 'tis probable therefore, fays he, That the Invention of Pipes and Whistles was owing to their Diversions and : ..

and Exercises on these Occasions; and because Men could not be long without having Use for Chords of various Kinds, and variously bent, thefe, either by being exposed to the Wind, or necessarily touched by the Hand, might give the first Hint of stringed Instruments; and because, even in the first simple Way of Living, they could not be long without some fabrile Arts, this would give Occasion to observe various Sounds of hard and hollow Bodies, which might raise the first Thought of the pulsatile Instruments; hence he concludes that Musick was a-

mong the first Arts.

If we consider next, the Opinion of those that are Ancients to us, who yet were too far from the Beginning of Things to know them any other way than by Tradition and probable Conjecture; we find an universal Agreement in this Truth, That Musick is as ancient as the World it felf, for this very Reason, that it is natural to Mankind. It will be needless to bring many Authorities, one or Two shall ferve: Plutarch in his Treatise of Musick, which is nothing but a Conversation among Friends, about the Invention, Antiquity and Power of Mufick, makes one afcribe the Invention to Amphion the Son of Jupiter and Antiopa, who was taught by his Father; but in the Name of another he makes Apollo the Author, and to prove it, alledges all the ancient Statues of this God, in whose Hand a musical Instrument was always put. He adduces many Examples to prove the natural Influence Musick has upon the

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the Mind of Man, and fince he makes no less than a God the Inventor of it, and the Gods existed before Men, 'tis certain he means to prove, both by Tradition and the Nature of the Thing, that it is the most ancient as well as the most Quintilian (Lib. 1. Cap. 11.) noble Science. alledges the Authority of Timagenes to prove that Musick is of all the most ancient Science; and he thinks the Tradition of its Antiquity is fufficiently proven by the ancient Poets, who represent Musicians at the Table of Kings, finging the Praises of the Gods and Heroes. Homer shews us how far Musick was advanced in his Days, and the Tradition of its yet greater Antiquity, while he fays it was a Part of his Hero's Education. The Opinion of the divine Original and Antiquity of Musick, is also proven by the Fable of the Muses, so univerfal among the Poets; and by the Disputes among the Greek Writers concerning the first Authors, fome for Orpheus, tome for Amphion, some for Apollo, &c. As the best of the Philosophers own'd the Providence of the Gods, and their particular Love and Benevolence to Mankind, so they also believed that Musick was from the Beginning a peculiar Gift and Favour of Heaven; and no Wonder, when they looked upon it as necessary to assist the Mind to a raised and exalted Way of praising the Gods and good Men.

I shall add but one Testimony more, which is that of the faceed Writings; where Fubal the Sixth from Adam, is called the Father

ther of such as handle the Harp and Organ; whether this fignifies that he was the Inventor. or one who brought these Instruments to a good Perfection, or only one who was eminently skilled in the Performance, we have fufficient Reafon to believe that Musick was an Art long before his Time; fince it is rational to think that vocal Musick was known long before Instrumental, and that there was a gradual Improvement in the Art of modulating the Voice; unless Adam and his Sons were inspired with this Knowledge, which Supposition would prove the Point at once. And if we could believe that this Art was lost by the Flood, yet the same Nature remaining in Man, it would foon have been revered; and we find a notable Instance of it in the Song of Praise which the Israelites raised with their Voices and Timbrels to GOD, for their Deliverance at the Red Sea; from which we may reasonably conjecture it was an Art well known, and of established Honour long ofore that Time.

It may be expected I should, in this Place, give a more particular History of the Inventors of Musick and musical Instruments, and other famous Musicians since the Flood. As to the Invention, I think there is enough said already to show that Musick is natural to Mankind; and therefore instead of Inventors, the Enquiry ought properly to be about the Improvers of it; and I own it would come in very naturally here: But the Truth is, we have scarce any Thing left

left us we can depend upon in this Matter; or at least we have but very general Hints, and many of them contrary to each other, from Authors that fpeak of these Things in a transient Manner: And as we have no Writings of the Age in which Musick was first restored after the Flood, fo the Accounts we have are fuch uncertain Traditions, that no Two Authors agree in every Thing. Greece was the Country in Europe where Learning first flourished; and tho' we believe they drew from other Fountains, as Egypt and the more Eastern Parts, yet they are the Fountains to us, and to all the Western World: Other Antiquities we neither know for well, nor fo much of, at least of such as have any Pretence to a greater Antiquity; except the Fewish; and tho' we are sure they had Musick; yet we have no Account of the Inventors among them, for its probable they learned it in Egypt; and therefore this Enquiry about the Inventors of Musick fince the Flood, must be limited to Greece. PLUTARCH, JULIUS POL-IUX, ATHENEUS, and a few more, are the Authorities we have principally to trust to, who take what they fay from other more ancient Authors of their Tradition. I hope to be for-given if I am very short in the Account of Things of fuch Uncertainty.

AMPHION, the Theban, is by some reckoned the most ancient Musician in Greece, and the Inventor of it, as also of the Lyra. Some say Mercury taught him, and gave him a Lyre of Seven Strings. He is faid to be the first who taught

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taught to play and fing together. The Time

he lived in is not agreed upon.
CHIRON the Pelithronian, reckoned a Demigod, the Son of Saturn and Phyllira, is the next great Master; the Inventor of Medicine: a famous Philosopher and Musician, who had for his Scholars Asculapius, Fason, Hercules, Thefeus, Achilles, and other Heroes.

DEMODOCUS is another celebrated Musi-

cian, of whom already.

HERMES, OF MERCURY TRISMEGISTUS, another Demigod, is also reckoned amongst the Inventors or Improvers of Musick and of the Lyra.

LINUS was a famous Poet and Musician. Some fay he taught Hercules, Thamyris and Orpheus, and even Amphion. To him some af-

cribe the Invention of the Lyra.

मिंद्र के लिये एंद्र होते हैं सिंद्र कि मिंद्र मिंद्र

OLYMPUS the Mysian is another Benefactor to Mufick; he was the Disciple of Marsyas the Son of Hyagnis the Phrygian; this Hyagnis is reckoned the Inventor of the Tibia, which others ascribe to the Muse Euterpe, as Horace infinuates, - Si neque tibias Euterpe cohibet.

ORPHEUS the Thracian is also reckoned the Author, or at least the Introducer of various Arts into Greece, among which is Musick; he pactifed the Lyra he got from Mercury. Some fay he was Master to Thampris and Linus.

PHEMIUS of Ithaca. Ovid uses his Name for any excellent Musician; Homer also names

him honourably.

thought.

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TERPANDER the Lesbian, liv'd in the Time of Lycurgus, and fet his Laws to Musick. He was the first who among the Spartans applied Melody to Poems, or taught them to be sung in regular Measures. This is the samous Musician who quelled a Sedition at Sparta by his Musick: He and his Followers are said to have first instituted the musical Modes, used in singing Hymns to the Gods; and some attribute the Invention of the Lyre to him.

THALES the Cretan was another great Mafler, honourably entertain'd by the Lacedemonians, for instructing their Youth. Of the Wonders he wrought by his Musick, we shall hear

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THAMYRIS the Thracian was so famous; that he is seigned to have contended with the Muses, upon Condition he should posses all their Power if he overcame, but if they were Victors he consented to lose what they pleased; and being defeat, they put out his Eyes, spoiled his Voice, and struck him with Madness. He was the first who used instrumental Musick without Singing.

THESE are the remarkable Names of Muficians before Homer's Time, who himself was a Musician; as was the samous Poet Pindar. You may find the Characters of these mentioned at more large, in the first Book of Fabritius's

Bibliotheca Graca.

We find others of a later Date, who were tamous in Musick, as Lasus Hermionensis, Melanippides, Philoxenus, Timotheus, Phrynnis, Gg 2 Epi-

Epigonius, Lysander, Simmicus, Diodorus the Theban; who were Authors of a great Variety and luxurious Improvements in Musick. Lasus, who lived in the Time of Darius Hystaspes, is reckoned the first who ever wrote a Treatise upon Musick. Epigonius was the Author of an Instrument called Epigonium, of 40 Strings; he introduced Playing on the Lyre with the Hand without a Plettrum; and was the first who joyned the Cithara and Tibia in one Concert, altering the Simplicity of the more ancient Musick; as Lysander did by adding a great many Strings to the Cithara. Simmicus also invented an Instrument called Simmicium of 35 Strings. Diodorus improved the Tibia, which at first had but Four Holes, by contriving more Holes and Notes.

TIMOTHEUS, for adding a String to his Lyre was fined by the Lacedemonians, and the String ordered to be taken away. Of him and Phrynnis, the Comic Poet Pherecrates makes bitter Complaints in the Name of Musick, for corrupting and abusing her, as Plutarch reports: For, among others, they chiefly had completed the Ruin of the ancient simple Musick, which, fays Plutarch, was nobly useful in the Education and forming of Youth, and the Service of the Temples, and used principally to these Purposes, in the ancient Times of greatest Wisdom and Virtue; but was ruined after theatrical Shews came to be fo much in Fashion, so that scarcely the Memory of these ancient Modes remained in his Time. You shall have some Account

Account afterwards of the ancient Writers of Musick.

As we have but uncertain Accounts of the Inventors of musical Instruments among the Ancients, so we have as imperfect an Account of what these Instruments were, scarce knowing them any more than by Name. The general Division of Instruments is into stringed Instruments, Wind Instruments and the pulsatile Kind; of this last we hear of the Tympanum or Cymbalum, of the Nature of our Drum; the Greeks gave it the last Name from its Figure, resembling a Boat.

THERE were also the Crepitaculum, Tintinabulum, Crotalum, Sistrum; but, by any Accounts we have, they look rather like Childrens Rattles and Play Things than musical Instru-

ments.

OF Wind-instruments we hear of the Tibia, fo called from the Shank-bone of fome Animals, as Cranes, of which they were first made. And Fistula made also of Reeds. But these were afterwards made of Wood and also of Mettal. How they were blown, whether as Flutes or Hautboys or otherwise, and which the one Way, and which the other, is not fufficiently manifest. 'Tis plain, fome had Holes, which at first were but few, and afterwards increafed to a greater Number; fome had none. Some were fingle Pipes, and some a Combination of feverals, particularly PAN's Syringa, which confifted of Seven Reeds joyned together fide-Gg3

fideways; they had no Holes, each giving but one Note, in all Seven distinct Notes; but at what mutual Distances is not very certain, tho' perhaps they were the Notes of the natural or diatonick Scale; but by this Means they would want an 8ve, and therefore probably otherwife constituted. Sometimes they played on a single Pipe, fometimes on Two together, one in each Hand. And left we should think there could little Musick be exprest by one Hand, If. Vossius alledges, they had a Contrivance by which they made one Hole express several Notes, and cites a Passage of Arcadius the Grammarian to prove it: That Author fays, indeed, that there were Contrivances to shut and open the Holes, when they had a Mind, by Pieccs of Horn he calls Bombyces and Opholmioi (which Julius Pollux also mentions as Parts of some Kind of Tibia) turning them upwards or downwards, inwards or outwards: But the Use of this is not clearly taught us, and whether it was that the fame Pipe might have more Notes than Holes, which might be managed by one Hand: Perhaps it was no more than a like Contrivance in our common Bagpipes, for tuning the Drones to the Key of the Song. We are also told that Hyagnis contrived the joyning of Two Pipes, fo that one Canal conveyed Wind to both, which therefore were always founded together.

We hear also of Organs, blown at first by a Kind of Air-pump, where also Water was some way used, and hence called Organum Hydraulicum; but afterwards they used Bellows. Vitru-

vius has an obscure Description of it, which Is. Vollius and Kircher both endeavour to clear.

THERE were Tuba, and Cornua, and Litui, of the Trumpet Kind, of which there were different Species invented by different People. They talk of some Kind of Tube, that without any Art in the Modulation, had fuch a prodigious Sound, that was enough to terrify

one.

OF stringed Instruments the first is the Lyra or Cithara (which some distinguish:) Mercury is faid to be Inventor of it, in this Manner; after an Inundation of the Nile he found a dead Shell-fift, which the Greeks call Chelone, and the Latins Testudo; of this Shell he made his I.yre, mounting it with Seven Strings, as Lucian fays; and added a Kind of jugum to it, to lengthen the Strings, but not fuch as our Violins have, whereby one String contains feveral Notes; by the common Form this jugum feems no more than Two distinct Pieces of Wood, set parallel, and at some Distance, but joyn'd at the farther End, where there is a Head to receive Pins for stretching the Strings. Boethius reports the Opinion of fome that fay, the Lyra Mercurii had but Four Strings, in Imitation of the mundane Musick of the Four Elements: But Diodorus Siculus fays, it had only Three Strings, in Imitation of the Three Seafons of the Year, which were all the ancient Greeks counted, viz. Spring, Summer and Winter. Nicomachus, Horace, Lucian and others fay, it had Seven Strings, in Imitation of the Seven Planets. Some reconcile Diodorus Gg4

odorus, with the last, thus, they fay the more ancient Lyre had but Three or Four Strings, and Mercury added other Three, which made up Seven. Mercury gave this Seven-stringed Lyre to Orpheus, who being torn to Pieces by the Bacchanals, the Lyre was hung up in Apollo's Temple by the Lesbians: But others fay, Pythagoras found it in some Temple of Egypt, and added an eighth String. Nicomachus fays, Orpheus being killed by the Thracian Women, for contemning their Religion in the Bacchanalian Rites, his Lyre was cast into the Sea, and thrown up at Antissa a City of Lesbos; the Fishers finding it gave it to Terpander, who carrying it to Egypt, gave it to the Priests, and call'd himself the Inventor. Those who call it Four-string'd, make the Proportions thus, betwixt the Ist and 2d, the Interval of a 4th, 3:4, betwixt the 2d and 3d, a Tone 8:9, and betwixt the 3d and 4th String another 4th: The Seven Strings were diatonically disposed by Tones and Semitones, and Pythagoras's eighth String made up the Octave.

THE Occasion of ascribing the Invention of this Instrument to so many Authors, is probably, that they have each in different Places invented Instruments much resembling other. However simple it was at first, it grew to a great Number of Strings; but 'tis to no Purpose to repete the Names of these who are supposed to have ad-

ded new Strings to it.

FROM this Instrument, which all agree to be first of the stringed Kind in Greece, arose a Multitude

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Number of Strings, of which we have but indistringt Accounts. We hear of the Pfalterium,
Trigon, Sambuca, Pectis, Magadis, Barbiton,
Testudo (the Two last used by Horace promiscuously with the Lyra and Cithara) Epigonium, Simmicium, Pandura, which were all
struck with the Hand or a Plectrum; but it
does not appear that they used any Thing like
the Bows of Hair we have now for Violins,
which is a most noble Contrivance for making
long and short Sounds, and giving them a thousand Modifications its impossible to produce by
a Plectrum.

Kircher also observes, that in all the ancient Monuments, where Instruments are put in the Hands of Apollo and the Muses, as there are many of them at Rome fays he, there is none to be found with fuch a jugum as our Violins have, whereby each String has feveral Notes, but every String has only one Note: 'And this he makes an Argument of the Simplicity and Imperfection of their Instruments. Besides several Forms of the Lyra Kind, and some Fistula, he is positive they had no Instruments worth naming. He confiders how careful they were to transmit, by Writing and other Monuments, their most trifling Inventions, that they might not lose the Glory of them; and concludes, if they had any Thing more perfect, we should certainly have heard of it, and had it preferved, when they were at Pains to give us the Fi474 A TREATISE CHAP. XIV.

gure of their trifling Reed-pipes, which the Shepherds commonly used. But indeed I find some Passages, that cannot be well understood, without supposing they had Instruments in which one String had more than one Note: Where Pherecrates (already mention'd) makes Musick complain of her Abuses from Timotheus's Innovations; she says, he had destroyed her who had Twelve Harmonies in Five Strings; whether these Harmonies signify single Notes or Consonances, 'tis plain each String must have afforded more than one Note. And Plutarch ascribes to Terpander a Lyre of Three Chords, yet he says it had Seven Sounds, i. e. Notes.

I have now done as much as my Purpose required. If you are curious to hear more of this, and see the Figures of Instruments both ancient and modern, go to *Mersennus* and *Kircher*.

^{§ 3.} Of the Excellency and various Uses of Musick.

Tho' the Reasons alledged for the Antiquity of Musick, shew us the Dignity of it, yet I believe it will be agreeable, to enter into a more particular History of the Honour Musick was in among the Ancients, and of its various Ends and Uses, and the pretended Virtues and Powers of it.

THE Reputation this Art was in with the Jewish Nation, is I suppose well known by the Jacred History. Can any Thing shew the Excellency of an Art more, than that it was reckoned useful and necessary in the Worship of GoD; and as fuch, diligently practifed and cultivated by a People, separated from the rest of Mankind, to be Witnesses for the Almighty, and preserve the true Knowledge of God upon the Earth? I have already mentioned the Instance of the Israelites Song, upon their Delivery at the Red Sea, which feems to prove that Musick both vocal and instrumental, was an approven and stated Manner of worshipping God: And we cannot doubt that it was according to his Will, for Moses the Man of God, and Miriam the Prophetess, were the Chiefs of this facred Choir: And that from this Time to that of the Royal Prophet David, the Art was honoured and encouraged by them both publickly and privately, we can make no Doubt; for when Saul was troubled with an evil Spirit from the LORD, he is advised to call for a cunning Player on the Harp, which supposes it was a well known Art in that Time; and behold, David, yet an obscure and private Person, being famous for his Skill in Musick, was called; and upon his playing, Saul was refreshed and was well, and the evil Spirit departed from him. Nor when David was advanced to the Kingdom thought he this Exercise below him, especially the religious Use of it. When the Ark was brought from Kirjath-jearim, David and alz all Ifrael played before GOD with all their Might, and with Singing, and with Harps, and with Pfalteries, and with Timbrels, and with Cymbals, and with Trumpets, 1 Chron. 13. 8. And the Ark being fet up in the City of David, what a folemn Service was instituted for the publick Worship and Praise of GoD; Singers and Players on all Manner of Instruments, to minister before the Ark of the LORD continually, to record, and to thank, and praise the Lord GOD of ISRAEL. These seem to have been divided into Three Choirs, and over them appointed Three Choragi or Masters, Asaph, Heman and Feduthun, both to instruct them, and to preside in the Service: But David himself was the chief Musician and Poet of Israel. And when Solomon had finished the Temple, behold, at the Dedication of it, the Levites which were the Singers, all of them of Afaph, of Heman, of Jeduthun, having Cymbals, and Psalteries, and Harps, stood at the East-end of the Altar, praising and thanking the LORD. And this Service, as David had appointed before the Ark, continued in the Temple; for we are told, that the King and all the People having dedicated the House to God,-The Priests waited on their Offices: the Levites also with Instruments of Musick of the LORD, which David the King had made to praise the LORD.

THE Prophet Elisha knew the Virtue of Musick, when he called for a Minstrel to compose his Mind (as is reasonably supposed) before the Hand of the LORD came upon him.

To

To this I shall add the Opinion and Testimony of St. Chrysoftom, in his Commentary on the 40th Pfalm. He fays to this Purpose, That God knowing Men to be flothful and 'backward in spiritual Things, and impatient of the Labour and Pains which they require, willing to make the Task more agreeable, and prevent our Weariness, he joyn'd Melody or Musick with his Worship; that as we are all naturally delighted with harmonious Numbers, we might with Readiness and Cheerfulness of Mind express his Praise in facred Hymns. For, fays he, nothing can raise the Mind, and, as it were, give Wings to it, free it from Earthliness, and the Confinement 'tis under by Union with the Body, inspire it with the Love of Wisdom, and make every thing pertaining to this Life agreeable, as well modulated Verse and divine Songs harmoniously composed. Our Natures are so delighted with Mulick, and we have so great and necessary Inclination and Tendency to this Kind of Pleafure, that even Infants upon the Breast are foothed and lulled to Rest by this means. Again he fays, ' Because this Pleasure is so familiar and connate with our Minds, that we might have both Profit and Pleasure, God appointed Pfalms, that the Devil might not ruine us with prophane and wicked Songs. And tho' there be now some Difference of Opinion about its Use in facred Things, yet all Christians keep up the Practice of singing Hymns and Pfalms, which is enough to confirm the general

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neral Principle of Musick's Suitableness to the

Worship of God.

In St. John's Vision, the Elders are reprefented with Harps in their Hands; and tho' this be only representing Things in Heaven, in a Way easiest for our Conception, yet we must suppose it to be a Comparison to the best Manner of worshipping God among Men, with respect at least to the Means of composing and raising our Minds, or keeping out other Ideas, and thereby fitting us for entertaining religious

Thoughts.

LET us next confider the Esteem and Use of it among the ancient Greeks and Romans. 'The Glory of this Art among them, especially the Greeks, appears first, according to the Obfervation of Quintilian, by the Names given to the Poets and Musicians, which at the Begining were generally the fame Perfon, and their Characters thought to be fo connected, that the Names were reciprocal; they were called Sages or Wisemen, and the inspired. Salmuth on Pancirollus cites Aristophanes to prove, that by cithare callens, or one that was skilled in playing on the Cithara, the Ancients meant a Wifeman, who was adorned with all the Graces; as they reckoned one who had no Ear or Genius to Mulick, stupid, or whose Frame was difordered, and the Elements of his Composition at War among themselves. And so high an Opithion they had of it, that they thought no Inchuftry of Man could attain to fuch an excellent Art; and hence they believed this Faculty Ligat to

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to be an Inspiration from the Gods; which also appears particularly by their making Apollo the Author of it, and then making their most ancient Musicians, as Orpheus, Linus, and Amphion, of divine Offspring. Homer, who was himfelf both Poet and Musician, could have suppofed nothing more to the Honour of his Profeffion, than making the Gods themselves delighted with it; after the fierce Contest that happened among them about the Grecian and Trojan Affairs, he feigns them recreating themselves with Apollo's Musick; and after this, 'tis no Wonder he thought it not below his Hero to have been instructed in, and a diligent Practifer of this Godlike Art. And do not the Poets univerfally testify this Opinion of the Excellency of Musick, when they make it a Part of the Entertainment at the Tables of Kings; where to the Sound of the Lyre they fung the Praifes of the Gods and Heroes, and other ufeful Things: As Homer in the Ody fea introduces Demodocus at the Table of Alcinous, King of Pheacea, finging the Trojan War and the Praifes of the Heroes: And Virgil brings in Jopas at the Table of Dido, finging to the Sound of his golden Harp, what he had learned in natural Philosophy, and particularly in Astronomy from Atlas; upon which Quintilian makes this Reflection, that hereby the Poet intends to shew the Connection there is betwixt Musick and heavenly Things; and Horace teaches us the same Doctrine, when addressing his Lyre, he

cries out, O decus Phabi, & dapibus supremi,

grata testudo, Fovis.

At the Beginning, Musick was perhaps fought only for the fake of innocent Pleasure and Recreation; in which View Aristotle calls it the Medicine of that Heaviness that proceeds from Labour; and Horace calls his Lyre laborum dulce lenimen: And as this is the first and most fimple, fo it is certainly no despicable Use of it; our Circumstances require such a Help to make us undergo the necessary Toils of Life more cheerfully. Wine and Musick cheer the Heart, faid the wife Man; and that the fame Power still remains, does plainly appear by universal Experience. Men naturally feek Pleafure, and the wifer Sort studying how to turn this Defire into the greatest Advantage, and mix the utile dulci, happily contrived, by bribing the Ear, to make Way into the Heart. The feverest of the Philosophers approved of Musick, because they found it a necessary Means of Access to the Minds of Men, and of engaging their Passions on the Side of Virtue and the Laws; and fo Musick was made an Handmaid to Virtue and Religion.

JAMBLICHUS in the Life of Pythagoras tells us, That Musick was a Part of the Discipline by which he formed the Minds of his Scholars. To this Purpose he made, and taught them to make and sing, Verses calculated against the Passions and Diseases of their Minds; which were also sung by a Chorus, standing round one that plaid upon the Lyre, the Modulations whereof

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whereof were perfectly adapted to the Delign and Subject of the Verses. He used also to make them sing some choice Verses out of Homer and Hestod. Musick was the first Exercise of his Scholars in the Morning; as necessary to sit them for the Duties of the Day, by bringing their Minds to a right Temper; particularly he designed it as a Kind of Medicine against the Pains of the Head, which might be contracted in Sleep: And at Night, before they went to rest, he taught them to compose their Minds after the Perturbations of the Day,

by the same Exercise.

WHATEVER Virtue the Pythagoreans afcribed to Musick, they believed the Reason of it to be. That the Soul it felf confifted of Harmony; and therefore they pretended by it to revive the primitive Harmony of the Faculties of the Soul. By this primitive Harmony they meant that which, according to their Doctrine, was in the Soul in its pre-existent State in Heaven. Macrobius, who is plainly Pythagorean in this Point, affirms, That every Soul is delighted with musical Sounds; not the polite only but the most barbarous Nations practife Mufick, whereby they are excited to the Love of Vertue, or dissolved in Softness and Pleasure: The Reason is, says he, That the Soul brings into the Body with it the Memory of the Musick which it was entertained with in Heaven: And there are certain Nations, fays he, that attend the Dead to their Burial with Singing; because they believe the Soul returns to Heaventhe Fountain

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or Original of Musick, Lib. 2. in Somnium Scipionis. And because this Sect believed the Gods themselves to have celestial Bodies of a most perfect harmonious Composition, therefore they thought the Gods were delighted with it; and that by our Use of it in sacred Things, we not only compose our Minds, and sit them better for the Contemplation of the Gods, but imitate their Happiness, and thereby are acceptable to them, and open for our selves a Return into Heaven.

ATHENAEUS reports of one Clinias a Pythagorean, who, being a very cholerick and wrathful Man, as foon as he found his Passion begin to rise, took up his Lyre and sung, and by this means allayed it. But this Discipline was older than Pythagoras; for Homer tells us, That Achilles was educated in the same manner by Chiron, and seigns him, after the hot Dispute he had with Agamemnon, calming his Mind with his Song and Lyre: And tho Homer should be the Author of this Story, it shows however that such an Use was made of Musick in his Days; for 'tis reasonable to think he had learned this from Experience.

The virtuous and wife Socrates was no lessa Friend to this admirable Art; for even in the Decline of his Age he applied himself to the Lyre, and carefully recommended it to others. Nor did the divine Plato dister from his great Master in this Point; he allows it in his Common-wealth; and in many Places of his Works speaks with the greatest Respect of it, as a most useful Thing in Society;

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he says it has as great Influence over the Mind, as the Air has over the Body; and therefore he thought it was worthy of the Law to take Care of it: He understood the Principles of the Art so well that, as Quintilian justly observes, there are many Passages in his Writings not to be understood without a good Knowledge of it. Aristotle in his Politicks agrees with Plato in

his Sentiments of Mulick.

ARISTIDES the Philosopher and Musician, in the Introduction to his Treatife on this Subject, fays, 'tis not so confined either as to the Subject Matter or Time as other Arts and Sciences, but adds Ornament to all the Parts and Actions of human Life: Painting, fays he, attains that Good which regards the Eye, Medicine and Gymnastick are good for the Body, Dialectick and that Kind helps to acquire Prudence, if the Mind be first purged and prepared by Musick: Again, it beautifies the Mind with the Ornaments of Harmony, and forms the Body with decent Motions: 'Tis fit for young ones, because of the Advantages got by Singing; for Persons of more Age, by teaching them the Ornaments of modulate Diction, and of all Kinds of Eloquence; to others more advanced it teaches the Nature of Number, with the Variety of Proportions, and the Harmony that thereby exists in all Bodies, but chiefly the Reasons and Nature of the Soul. He says, as wife Husband-men first cast out Weeds and noxious Plants, then fow the good Seed, fo Mulick is used to compose the Mind, and fit it for Hh2

receiving Instruction: For Pleasure, says he, is not the proper End of Musick, which affords Recreation to the Mind only by accident, the proposed End being the instilling of Virtue. Again, he says, if every City, and almost every Nation loves Decency and Humanity, Musick

cannot possibly be useless.

It was used at the Feasts of Princes and Heroes, says Athenaus, not out of Levity and vain Mirth; but rather as a Kind of Medicine, that by making their Minds cheerful, it might help their Digestion: There, says he, they sung the Praises of the Gods and Heroes and other useful and instructive Composures, that their Minds might not be neglected while they took Care of their Bodies; and that from a Reverence of the Gods, and by the Example of good Men, they might be kept within the Bounds of Sobriety and Moderation.

But we are not confined to the Authority and Opinion of Philosophers or any particular Persons; we have the Testimony of whole Nations where it had publick Encouragement, and was made necessary by the Law; as in the most Part of the Grecian Common-wealths.

ATHENAEUS affures us, That anciently all their Laws divine and civil, Exhortations to Vertue, the Knowledge of divine and human Things, the Lives and Actions of illustrious Men, and even Histories and mentions Herodotus, were written in Verse and publickly sung by a Chorus, to the Sound of Instruments; they found this by Experience an effectual means to im-

impress Morality, and a right Sense of Duty: Men were attentive to Things that were proposed to them in such a sweet and agreeable Manner, and attracted by the Charms of harmonious Numbers, and well modulated Sounds, they took Pleasure in repeating these Examples and Instructions, and found them easier retained in their Memories. Aristotle also in his Problems tells us, That before the Use of Letters, their Laws were fung musically, for the better retaining them in Memory. In the Story of Orpheus and Amphion, both of them Poets and Musicians, who made a wonderful Impression upon a rude and uncultivated Age, by their virtuous and wife Instructions, inforced by the Charms of Poetry and Musick: The fucceeding Poets, who turned all Things into Mystery and Fable, feign the one to have drawn after him, and tamed the most favage Beafts, and the other to have animated the very Trees and Stones, by the Power of Musick. Horace had received the fame Traditions of all the Things I have now narrated, and with these mentions other Uses of Musick. The Passage is in his Book de arte Poetica, and is worth repeating.

Silvestres homines, sacer interpresq; deorum, Cadibus & victu sado, deterruit Orpheus:
Dictus ob hoc lenire tigres, rabidosq; leones:
Dictus & Amphion, Thebana conditor arcis,
Saxa movere sono testudinis, & prece blanda
Ducere quo vellet. Fuit hac sapientia quondam,
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Publica privatis secernere, sacra profanis:
Concubitu prohibere vago: dare sacra maritis:
Oppida moliri: leges incidere ligno:
Sic honor, & nomen divinis vatibus, atque
Carminibus venit. Post hos insignis Homerus,
Tyrtæusq; mares animos in martia bella
Versibus exacuit. Dieta per carmina sortes:
Et vita monstrata via est: & gratia regum
Pieriis tentata modis: ludusq; repertus,
Et longorum operum sinis: ne forte pudori,
Sit tibi musa lyra solers, & cantor Apollo.

FROM these Experiences I say, the Art was publickly honour'd by the Governments of Greece. It was by the Law made a necessary Part of the Education of Youth. Plato assures us it was thus at Athens; in his first Alcibiades, he mentions to that great Man, in Socrates's Name, how he was taught to read and write, to play on the Harp, and wrestle. And in his Crito, he fays, did not the Laws most reasonably appoint that your Father should educate you in Musick and Gymnastick? And we find these Three Grammar, Musick and Gymnastick generally named together, as the known and necessary Parts of the Education of Youth, especially of the better Sort: Plutarch and Athenaus give abundant Testimony to this; and Terence having laid the Scene of his Plays in Greece, or rather only translated, and at most but imitated Menander, gives us another Proof, in the Act 3. Scene 2, of his Eunuch. Fac periculum in literis, fac in palæstra, in musicis. Que liberum Scire aquum est adolescentem solertem dabo. THE

THE Use of Musick in the Temples and folemn Service of their Gods is past all question. Plato-in his Dialogues concerning the Laws, gives this Account of the facred Musick. imo. That every Song confift of pious Words. 2do. That we pray to God to whom we facrifice. 3tio. That the Poets, who know that Prayers are Petitions or Requests to the Gods, take good Heed they don't ask Ill instead of Good, and do nothing but what's just, honest, good and agreeable to the Laws of the Society; and that they shew not their Compositions to any private Person, before those have seen and approven them who are appointed Judges of these Things, and Keepers of the Laws: Then, Hymns to the Praises of the Gods are to be fung, which are very well connected with Prayer; and after the Gods, Prayers and Praises are to be offered to the Damons and Heroes.

As they had poetical Compositions upon various Subjects for their publick Solemnities, so they had certain determinate Modes both in the Harmonia and Rythmus, which it was unlawful to alter; and which were hence called Nomi or Laws, and Musica Canonica. They were jealous of any Innovations in this Matter, fearing that a Liberty being allowed, it might be abused to Luxury; for they believed there was a natural Connection betwixt the publick Manners and Musick: Plato denied that the missional Modes or Laws could be changed without a Change of the publick Laws; he meant, the H h 4

Influence of Musick was so great, that the Changes in it would necessarily produce a proportional Change of Manners and the publick Constitution.

THE Use of it in War will easily be allowed to have been by publick Authority; and the Thing we ought to remark is, that it was not used as a mere Signal, but for inspiring Courage, raising their Minds to the Ambition of great Actions, and freeing them from base and cowardly Fear; and this was not done without great Art, as Virgil shews when he speaks of Misenus,

Ere ciere viros, martemque accendere cantu.

FROM Athens let us come to Lacedemon, and here we find it in equal Honour. Their Opinion of its natural Influence was the fame with that of their Neighbours: And to shew what Care was taken by the Law, to prevent the Abuse of it to Luxury, the Historians tell us that Timotheus was fined for having more than Seven Strings on his Lyre, and what were added ordered to be taken away. The Spartans were a warlike People, yet very sensible of the Advantage of fighting with a cool and deliberate Courage; therefore as Gellius out of Thucydides reports, they used not in their Armies, Instruments of a more vehement Sound, that might inflame their Temper and make them more furious, as the Tuba, Cornu and Lituus, but but the more gentle and moderate Sounds and Modulations of the Tibia, that their Minds being more composed, they might engage with a rational Courage. And Gellius tells us, the Cretans used the Cithara to the same Purpose in their Armies. We have already heard how this People entertain'd at great Expence the famous Thales to instruct their Youth in Musick; and after their Musick had been thrice corrupted, thrice they restored it.

If we go to Thebes, Epaminondas will be a Witness of the Esteem it was in, as Corn.

Nepos informs us.

ATHENEUS reports, upon the Authority of Theopompus, that the Getan Ambassadors, being sent upon an Embassy of Peace, made their Entry with Lyres in their Hands, singing and playing to compose their Minds, and make themselves Masters of their Temper. We need not then doubt of its publick Encouragement among

this People.

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But the most famous Instance in all Greece, is that of the Arcadians, a People, says Polybius, in Reputation for Virtue among the Greeks; especially for their Devotion to the Gods. Musick, says he, is esteem'd every where, but to the Arcadians it is necessary, and allowed a Part in the Establishment of their State, and an indispensable Part of the Education of their Children. And tho' they might be ignorant of other Arts and Sciences without Reproach, yet none might presume to want Knowledge in Musical

fick, the Law of the Land making it necessary; and Insufficiency in it was reckoned infamous among that People. It was not thus established, says he, so much for Luxury and Delight, as from a wife Consideration of their toilsom and industrious Life, owing to the cold and melancholy Air of their Climate; which made them attempt every Thing for softning and sweetning those Austerities they were condemned to. And the Neglect of this Discipline he gives as the Reason of the Barbarity of the Cynæthians a People of Arcadia.

We shall next consider the State of Musick among the ancient Romans. Till Luxury and Pride ruin'd the Manners of this brave Nation, they were famous for a severe and exact Virtue. And tho' they were convinced of the native Charms and Force of Musick, yet we don't find they cherished it to the same Degree as the Greeks; from which one would be tempted to think they were only afraid of its Power, and the ill Use it was capable of; a Caution that very well became those who valued themselves so much, and justly, upon their Piety and good

Manners.

CORN. NEPOS, in his Preface, takes Notice of the Differences betwixt the Greek and Roman Customs, particularly with respect to Musick; and in the Life of Epaminondas, he has these Words, Scimus enim musicum nostris moribus abesse a principis persona; saltare etiam in vitiis poni, qua omnia apud Gracos & gratia & laude digna ducuntur.

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CICERO in the Beginning of the first Book of his Tusculan Questions, tells us, that the old Romans did not study the more soft and polite Arts so much as the Greeks; being more addicted to the Study of Morality and Government: Hence Musick had a Fate somewhat different at Rome.

But the same Cicero shews us plainly his own Opinion of it. Lib. 2. de Legibus; Assentior enim Platoni, nihil tam facile in animos teneros atque molles influere quam varios canendi sonos. Quorum dici vix potest quanta sit vis in utramque partem, namque & incitat languentes, & languefacit incitatos, & tum remittit animos, tum contrahit. Certainly he had been a Witness to this Power of Sound, before he could speak so; and I shall not believe he had met with the Experiment only at Athens. A Man so samous for his Eloquence, must have known the Force of harmonious Numbers, and well proportioned Tones of the Voice.

QUINTILIAN speaks honourably of Musick. He says, Lib. 1. Chap. 11. Nature seems to have given us this Gift for mitigating the Pains of Life, as the common Practice of all labouring Men testifies. He makes it necessary to his Orator, because, says he, Lib. 8. Chap. 4. it is impossible that a Thing should reach the Heart which begins with choking the Ear; and because we are naturally pleased with Harmony, otherwise Instruments of Musick that cannot express Words would not make such surprising

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and various Effects upon us. And in another Place, where he is proving Art to be only Nature perfected, he fays, Musick would not otherwise be an Art, for there is no Nation which

has not its Songs and Dances.

Some of the first Rank at Rome practised it. Athenous says of one Masurius a Lawyer, whom he calls one of the best and wisest of Men, and inferior to none in the Law, that he applied himself to Musick diligently. And Plutarch places Musick, viz. singing and playing on the Lyre, among the Qualifications of Metella the Daugh-

ter of Scipio Metellus.

MACROBIUS in the 10 Chap. Lib. 2. of his Saturnalia shews us, that neither Singing nor Dancing were reckoned dishonourable Exercises even for the Quality among the ancient Romans; particularly in the Times betwixt the Two Punick Wars, when their Virtue and Manners were at the best; providing they were not studied with too much Curiosity, and too much Time spent about them; and observes that it is this, and not fimply the Use of these that Salust complains of in Sempronia, when he fays the knew pfallere & faltare elegantius quam necesse erat probæ. What an Opinion Macrobius himself had of Mulick we have in part shewn already; to which let us add here this remarkable Passage in the Place formerly cited. Ita denique omnis habitus anima cantibus gubernatur, ut & ad bellum progressui & etiam receptui canatur, cantu & excitante & rursus sedante virtutem; dat somnos adimitque, nec1-

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necnon curas & immittit & retrabit, iram suggerit, clementiam suadet, corporum quoque morbis medetur. Hinc est quod agris remedia prestantes precinere dicuntur. The Abuse of it, which 'tis probable lay chiefly in their idle, ridiculous and lascivious Dancing, or perhaps their fpending too much Time even in the most innocent Part of it, and not applying it to the true Ends, made the wifer Sort cry out, and brought the Character of a Musician into some Discredit. But we find that the true and proper Musick was still in Honour and Practice among them: Had Rome ever fuch Poets, or were they ever fo honoured as in Augustus's Reign? Horace, tho' he complains of the Abuse of the Theatre and the Musick of it, yet in many Places he shews us, that it was then the Practice to fing Verses or Odes to the Sound of the Lyre, or of Pipes, or of both together; Lib. 4. Ode 9. Verba loquor socianda chordis. Lib. 2. Ep. 2. Hic ego verba lyra motura sonum connestere digner? In the first Ode, Lib. 1. he gives us his own Character as a Poet and Musician, Si neque tibias Euterpe cohibet, &c. He shews us that it was in his Time used both publickly in the Praise of the Gods and Men, and privately for Recreation, and at the Tables of the Great, as we find clearly in these Passages. Lib. 4. Ode 11. Condisce modos amanda voce quos reddas, minuentur atræ carmine curæ. Lib. 3. Ode 28. Nos cantabimus invicem Neptunum, tu curva recines lyra Latonam, &c. Lib. 4. Ode 15. Nosque & profestis lucibus & sacris - Rite Deos

Deos prius adprecati, virtute functos more patrum duces, Lydis remisto carmine tibiis Trojamque, &c. canemus. Epode 9. Quando repostum cacubum ad festas dapes tecum. — Beate Mecanas bibam? Sonante mistis tibiis carmen lyra. Lib. 3. Ode 11. Tuque testudo — Nunc & divitum mensis & amica templis.

FOR all the Abuses of it, there were still some, even of the best Characters, that knew how to make an innocent Use of it: Sueton in Titus's Life, whom he calls Amor ac delicia generis humani, among his other Accomplishments adds, Sed ne Musica quidem rudis, ut qui can-

taret & psalleret jucunde scienterque.

THERE is enough faid to shew the real Value and Use of Musick among the Ancients. I believe it will be needless to insist much upon our own Experience; I shall only say, these Powers of Musick remain to this Day, and are as universal as ever. We use it still in War and in sacred Things, with Advantages that they only know who have the Experience. But in common Life almost every Body is a Witness of its sweet Influences.

What a powerful Impression musical Sounds make even upon the Brute Animals, especially the feathered Kind, we are not without some Instances. But how surprising are the Accounts we meet with among the old Writers? I have reserved no Place for them here. You may see a Variety of Stories in Elian's History of Animals:

mals, Strabo, Pliny, Marcianus Capella, and others.

BEFORE I leave this, I must take Notice of some of the extraordinary Effects a cribed to Musick. Pythagoras is said to have had an absolute Command of the human Passions, to turn them as he pleased by Musick: They tell us, that meeting a young Man who in great Fury was running to burn his Rival's House, Pythagoras allayed his Temper, and diverted the Delign, by the fole Power of Musick. The Story is famous how Timotheus, by a certain Strain or Modulation, fired Alexander's Temper to that Degree, that forgetting himself, in a warlike Rage he killed one of the Company; and by a Change of the Musick was softned again, even to a bitter Repentance of what he had done. But Plutarch speaks of one Antigenides a Tibicen or Piper, who by some warlike Strain had transported that Hero, so far that he fell upon some of the Company. Terpander quelled a Sedition at Sparta by means of Musick. Thales being called from Crete, by Advice of the Oracle, to Sparta, cured a raging Pestilence by the same Means. The Cure of Diseases by Mufick is talked of with enough of Confidence. Aulus Gellius Lib. 4. Chap. 13. tells us it was a common Tradition, that those who were troubled with the Sciatica (he calls them Ifchiaci) when their Pain was most exquisite, were eased by certain gentle Modulations of Musick performed upon the Tibia; and fays, he had read in Theophrastus that, by certain artful ModuModulations of the same Kind of Instrument, the Bites of Serpents or Vipers had been cured. Clytemnestra had her vicious Inclinations to Unchastity corrected by the Applications of Musicians. And a virtuous Woman is said to have diverted the wicked Design of two Rakes that assaulted her, by ordering a Piece of Musick to be performed in the Spondean Mode. The Truth and Reality of these Effects shall be considered afterwards.

of the Ancients; and their Scale of Mulick.

Indroduction. Of the ancient Writers on Musick.

THE SE Principles are certainly to be found no where, but among those who have written professedly upon the Subject; I shall therefore introduce what I'm to deliver, with a short Account of the ancient Writers upon Mu-

fick.

I have already observed, that the first Writer upon Musick was Lasus Hermionensis; but his Work is lost, as are the Works of very many more, both Greek and Latin, of which you'll find a large Catalogue in the 3d Book of Fabritius's Bibliotheca graca; where you'll also find an Account of some others, that are pretended to be still in Manuscript in some Libraries.

ries. Here I shall only say a few Words concerning these Authors that are still extant and

already made publick.

eldest Writer extant on this Subject; he calls his Book Elements of Harmonicks; and tho' in his Division he speaks of the rest of the Parts, yet he explains there only the Harmonica. He wrote a Treatise upon the other Parts, which is lost.

EUCLID, the Author of the Elements of Geometry, is next to Aristoxenus, he writes an

Introduction to Harmonicks:

ARISTIDES QUINTILIANUS Wrote after Cicero's Time; he calls his Book, Of Musick, because he treats of both the Harmonica and Rythmica.

ALYPIUS stands next, who writes only an Account of the Greek Semeiotica, or of the Signs by which the various Degrees of Tune were no-

ted in any Song.

GAUDENTIUS the Philosopher makes a Kind of short Compend of Aristoxenus, which

he calls an Introduction to Harmonicks.

NICOMACHUS the Pythagorean writes a Compend of Harmonicks, which he says was done at the Request of some great Woman, and promises a more complete Treatise of Musick: its supposed that Boethius had seen and made Use of it, from several Passages he cites, which are not in this Compend; but its lost since:

BACCHIUS a Follower of Aristoxenus, writes a very short Introduction to the Art of Musick

in Dialogue

OF

Or these Seven Greek Authors, we have a fair Copy, with Translation and Notes, by Meibomius.

thematician, about the Time of the Emperor Antoninus Pius, writes in Greek Three Books of Harmonicks. He strikes a Medium betwixt the Pythagoreans and Aristomenians, in explaining the harmonick Principles. Of this Author, with his prolix Commentator Porphyrius, we have a fair Copy with Translations and Notes, by the learned Doctor Wallis. Vol. III. of his mathematical Works. And from the same Hand we have also, with Translation and Notes.

MANUEL BRYENNIUS, long after any of the former, who writes of *Harmonicks*. In his first Book he follows *Euclid*, and in his 2d and 3d Ptolomy.

I have spoken of Plutarch's Book de Musica,

in the 6 1.

OF the Latins we have

BOETHIUS, in the Time of Theodorick the Goth; he writes de musica, but explains only the harmonick Principles; 'tis with his other Works.

MARTIANUS CAPELLA in the 9th Book of his Treatife de nuptiis Philologia & Veneris, writes de musica, in which he is but a forry Copier from Aristides. We have this Work with Meibomius's Collection of the Greek Writers.

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St. Augustin writes de musica, but he treats only of the Rythmi and pedes metrici;

'tis among his Works.

AURELIUS CASSIODORUS, in the Time of Theodorick, among his other Works, and particularly de artibus ac disciplinis liberalium literarum, treats de musica; 'tis a very short Sketch, amounting to no more than some general Designitions and Divisions.

THERE are one or Two more Authors; which I have not seen: But these mentioned contain the whole Doctrine that's lest us by the Ancients; and perhaps we might spare severals of these without great Loss, Two or Three of them containing the Whole; so true it is what Gerhard Vossus remarks of them, nempe alii alios illaudato more exscripserunt.

THESE then are the Authorities and Originals, from which I have taken the following Account of the ancient System of Musick. It will be needless therefore, after I have told you this, to make a troublesom and tedious Citati-

on for every Thing I mention.

Of the ancient HARMONICA.

How the ancient Writers defined and divided Musick has been explained in § 1. of this Ch: and needs not be repeted. My Business here is with the Part they called Harmonica, which treats of Sounds and their Differences, with respect to acute and grave. Prolony calls it a Power or Faculty perceptive of the Difference

of Sounds, with respect to Acuteness and Gravity; and Bryennius calls it a speculative and practical Science, of the Nature of the harmo-

nick Agreement in Sounds.

THEY reduce the Doctrine of Harmonicks into Seven Parts, viz. 1st. Of Sounds. 2d. Of Intervals. 3d. Of Systems. 4th. Of the Genera or different Kinds, with respect to the Constitution and Division of the Scale. 5th. Of the Tones or Modes. 6th. Of Mutations or Changes. 7th. Of the Melopaia or Art of making Melody or Songs. Of these in Order.

I, OF SOUND. This Ptolomy considers in a large Sense, comprehending the whole Object of Hearing, and calls it by a general Name ψοφος, i. e. Strepitus, or any Kind of Sound. As it is capable of a Difference in Acuteness and Gravity, Aristoxenus calls it Dovn, i. e. Vox, or Voice. As to the Nature and Cause of Sound, they agree that it is the Effect of the Percussion of the Air, whose Motion is propagated to the Ear, and there raises a Perception. The principal Difference they consider in Sounds is of Acuteness and Gravity, which is produced by a quicker or flower Motion in the Vibrations of the Air. A Sound confidered in a certain determinate Degree of Acuteness or Gravity, they call Possyos, i. e. Sonus; and they define it thus, Aristox. Φωνώς πλώσις έπλ μίαν τάσιν, δ. Φθοίγος, i. e. Sonus est vocis casus in unam tensionem. Aristides considers it with regard to its Use, and calls it Tagiv mexudiani, tensionem melodicam. Nicomachus defines it, - Dwins

φωνης έμμελες ἀπλατη τάσιν, vocis ad cantum apta tensionem, latitudinis expertem. Thus they distinguished Sounds, according as their Degree of Acuteness or Gravity was fit or not for Song; such as were fit were also called concinnous Sounds, and others inconcinnous. These Words wanting Latitude, were added to contradict a Notion of Lasus and the Epigonians, that a Voice could not possibly remain for any determinate Time in one Degree, but made continually some little Variations up and down, tho' not very sensible.

THEN they consider a Voice as changing from acute to grave, or from this to that; and hereby form the Notion of a Motion of the Voice, which they say is Twofold; the one concinnous, by which we change the Voice in common Speaking, the other discrete, as in Singing-See above Ch. 2. And some added a Third and middle Kind, whereby, say they, we read a Poem.

In Sounds (\$\Phi \text{Polyo}()\$) they consider Three Things, Tension, which is the Rest or Standing of the Voice in any Degree, Intension and Remission are the Motions of the Voice upward and downward, whereby it acquires Acuteness or Gravity: And when it moves, all the Distance or Difference betwixt the first and last Degree or Tension, they called the Place throwhich it moved. Then there is Distension or Difference of acute and grave, in which the Quantity that is the mathematical Object consists; this they said is naturally infinite, but with respect either to our Senses, or what Sounds we

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Difference of Two Sounds, in respect of acute and grave; or, that imaginary Space which is terminated by Two Sounds differing in Acute ness or Gravity. Intervals were considered as differing, 1 mo. in Magnitude. 2do. As the Extremes were Concord or Discord. 3tio. As composite or incomposite, that is, simple or composite or incomposite, that is, simple or composite or incomposite, that is, simple or composite of which again.) 5to. As rational or irrational, i. e. such as we can discern and measure, and which neither exceed our Capacities in Greatness or Littleness.

As to the measuring of Intervals, and, as Ptolomy calls it, the Criterions in Harmonicks, there was a notable Difference among the Philosophers, which divided them into Two Sects, the Pythagoreans and Aristocenians; betwist whom Ptolomy striking a Midst, made a Third Sect.

PYTHAGORAS and his Followers measured all the Differences of Acuteness and Gravity, by the Ratios of Numbers. They supposed these Differences to depend upon the different Velocities of the Motions that cause Sound; and thought therefore, that they could only be accurately measured by the Ratios of these Velocities. Which Ratios were first investigate by Pythagoras, as Nicomachus and others inform us, in this Manner, viz. Passing by a Smith's Shop, he perceived a Concord or Agreement betwixt the

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the Sounds of Hammers striking the Anvil: He went in, and made feveral Experiments, to find upon what the Difference really depended; and at last making Experiments upon Strings, which he stretched by various Weights, he found, fay they, that if Four Chords, in every Thing else equal and alike, are stretched by Weights, as 6.8.9.12. they yield the Concord of Octave betwixt the first and last. a 4th betwixt the first and Second, as also betwixt the Third and last, a 5th betwixt the first and Third, and also betwixt the Second and last; and that betwixt the Second and Third was exactly the Difference of 4th and 5th; being all proven by the Judgment of a well tuned Ear: Hence he determined these to be the true Ratios that accurately express these Intervals.

But we have found an Error in this Account. which Vincenzo Galileo, in his Dialogues of the ancient and modern Musick, is, for what I know, the first who observes; and from him Meibomius repetes it in his Notes upon Nicomachus. We know, that if Four Strings are in Length, as these Numbers 6.8.9.12. (cateris paribus) their Sounds make the Intervals mentioned. But whatever Ratio of Length makes any Interval, to make the fame by Two Chords, in every other Thing equal, but itretcht by different Weights, these Weights must be as the Squares of the unequal Lengths, i. e. for an Octave 1:4, for a 5th 4:9, and for a 4th 9:16. (See above Ch. 2.) Hence by the Ratios of the Lengths of Chords, which are reciprocally as the Ii4

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the Numbers of Vibrations, all the Differences of acute and grave are measured. The Pythagoreans justly reckoned that the minute Differences could by no means be trusted to the Ear, and therefore judged and measured all by Ra-

tios.

ARISTOXENUS on the contrary, thought Reason had nothing to do in the Case; that Sense was the only Judge; and that the other was too fubtil, to be of any good Use: He therefore took the 8ve, 5th and 4th, which are the first and most simple Concords by the Ear. By the Difference of the 4th and 5th he found the Tonus: And this being once fettled as an Interval the Ear could judge of, he pretended to measure every Interval by various Additions and Subductions made of these mentioned, one with another. Particularly, he calls Diateffaron equal to Two Tones and a Half; and taking Two Tones, or Ditonum, out of Diatelleron, the Remainder is the Hemitonium; then the Sum of Tonus and Hemitonium is the Triemitonium. To get an Idea of the Method of bringing out these Intervals, suppose Six Sounds a:b:c:d:e:f. If a is the lowest, we can by the Ear take d a 4th and e a 5th upward; then from e downward we can take b a 4th, fo that a: b and d: e are each the Tonus or Difference of 4th and 5th; also from b we can take upward f a 5th, and downward from f a 4th at c; hence we have other Two Tones b: 6 and e: f, also a Hemitonium c. d, a Ditonum g - c or d - f, a Triemitonium b - d or c - e. But

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But the Inaccuracy of this Method of determi-

ning Intervals is very great.

PTOLOMEY argues strongly against the last Sect, that while they own these different Ideas of acute and grave, which arise from the Relations of the Sounds among themselves; and that the Differences in the Lengths of Chords which yield these Sounds, are the same; yet they neither know nor enquire into the Relation: Rut as if the Interval were the real Thing, and the Sound the imaginary, they only compare the Differences of the Intervals, making by this Means a Shew of doing fomething in Musick by Number and Proportion; which yet, fays he, they act contrary to; for they don't determine what every Species is in it felf; as we define a Tone to be the Difference of Two Sounds which are to one another as 8:9; but they fend us to another Thing as indeterminate, when they call it the Difference of a 4th and 5th. Whereas if we would raife a Tone exactly, we need neither 4th nor 5th. And if we ask how great that Difference is, they cannot tell us; if perhaps they don't fay, 'tis equal to Two fuch Intervals, whereof Diatessaron contains 5, or Diapason 12, and so of the rest; but what that is they determine not. Again, by confidering the mere Interval, they do nothing at all; for the mere Distance is neither Concord nor concinnous, nor any Thing real; whereas by comparing Two Sounds together we determine the Ratio or Relation, and the Quality of their Difference, i. e. whether it constitutes Concord

or

or Discord, by the Form of that Ratio. Next, he shews the Fallacy of Aristoxenus's Demonstration, whereby he pretended to prove that a 4th was equal to Two Tones and a Half. I need not trouble you with it here; for we have learnt already that a Tone 8:9 is not divisible into Two equal Parts. But then he also finds fault with the Pythagoreans for some false Speculations about the Proportions; and having too little Re-

gard to the Judgment of the Ear, while they refuse some Concords that the Ear approves, only because the Ratio does not agree with their arbitrary Rule; as we shall hear immediate-

ly.

THEREFORE he would have Sense and Reafon always taken together in all our Judgments, about Sounds, that they may mutually help and confirm one another. And of all the Methods to prove and find the Ratios of Sounds, he recommends as the most accurate, this, viz. to stretch over a plain Table an evenly well made String, fixt and raifed equally at both Ends, over Two immoveable Bridges of Wood, fet perpendicularly to the Table, and parallel to each other; betwixt them a Line is to be drawn on the Table, and divided into as many equal Parts as you need, for trying all Manner of Ratios; then a moveable Bridge runs betwixt the other Two, which just touches the String, and being fet at the several Divisions of the Line, it divides the Chord into any Ratio of Parts; whose Sounds are to be compared together, or with

with the Sound of the Whole. This he calls Canon Harmonicus. And those who determined the Intervals this Way, were particularly called Canonici, and the others by the gene-

ral Name of Musici.

OF CONCORDS. They defined this, An Agreement of Two Sounds that makes them, either fuccessively or jointly heard, pleasant to the Ear. They owned only these Three simple ones, viz. the Fourth 3:4, and Fifth 2:3 called Dia-tessaron and Dia-pente, and the Octave 1: 2, which they called Dia-pajon; the Reafon of these Names we shall hear again. Of compound Concords, the Pythagoreans owned only the Sum of the 5th and 8ve 1:3, and the double 8ve 1: 4 or Dif-dia-pason, but others owned also the Sum of 4th and 8ve, 3:8. The Reason why the Pythagoreans rejected the compound 4th, 3:8 was, That they admitted nothing for Concord but the Intervals whose Ratios were multiple or superparticular, i. e. where the greater Term contained the other a precise Number of Times, as 3: 1, or where the greater exceeded the lesser only by 1, as 3:2 or 4:3. because these are the most simple and perfect Forms of Proportion : But Ptolomy argues against them from the Perfection of the Dia-pason, whereby 'tis impossible that any Sound should be Concord to its one Extreme, and Discord to the other. The Extremes Dia-pason and Disdia-pason, Ptolomy calls Omophoni or Unisons, because they agree as one Sound. The 4th and 5th and their ComCompounds he calls Synphoni or confonant; the or ther Intervals belonging to Musick he calls Emmeli or concinnous. Others call those of equal Degree Omophoni, the 8ves Antiphoni, the 4ths and 5ths Paraphoni; others call the 5ths only Paraphoni, and the 4ths Synphoni, but all agree to call the

Discords Diaphoni.

THE abstract Reasonings of the Pythagoreans about the Ratios of the Concords, you have in Ptolomy; but more particularly in Euclid's Sectio Canonis. The fundamental Principle is, That every Concord arises either from a Multiple or Superparticular Ratio. other necessary Premisses are. 1 mo. That a multiple Ratio twice compounded, (i. e. multiplied by 2,) makes the Total a multiple Ratio. Euclid proves it his own Way; but to our Purpose it is shorter done thus a: ra, and ra: rra, are both Multiples, and in the same Ratio; then a: rra is the Compound of these Two, and is also multiple. 2do. The Converse is true, that if any Ratio twice compounded makes the total Multiple, that Ratio is it felf multiple. 3tio. A superparticular Ratio, admits neither of one or more geometrical mean Proportionals: Which I thus demonstrate, viz. the Difference of the Terms being 1, 'tis plain there can be no middle Term in whole Numbers; but the first of any Number (1) of geometrical Means betwixt a and ati, (which represents any fuperparticular Ratio) is the nti Root of this Quantity anXati which being a whole Number, if it have no Root in whole Numbers, cannot have one in

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a mixt Number, that is, can have no Root at all; and confequently there can be no Mean betwixt a and at. Nor can the Matter be mended by multiplying the Terms of the Ratio, as if for a: a+1 we take ra: ra + r; because if we have not here a Mean in whole Numbers, we cannot have it at all; and if we have it in whole Numbers, then all the Series as well as the Extremes, will reduce to radical Terms contrary to the last Demonstr. 4to. From the 2d and 3d follows, that a Ratio not multiple being twice compounded, the Total is a Ratio, neither multiple nor superparticular. from the 2d follows, that if any Ratio twice composed make not a multiple Ratio, it self is not multiple. 5to, The multiple Ratio 2:1 (which is the least and most simple of the Kind) is composed of the Two greatest superparticular Ratios 3: 2 and 4: 3, and cannot be composed of any other Two that are Superparticular. From these Premisses the Concords are deduced thus: Diatesfaron and Diapente are Concords; and they must be superparticular Ratios, for neither of them twice composed makes a Concord; the Sum therefore not being multiple, the simple Ratio is not multiple; yet this Ratio being Concord, must be superparticular. Diapason and Disdiapason are both Concords, and they are also multiple: The Disdiapason cannot be superparticular, because it has a Mean (which is the Diapason,) therefore 'tis multiple; and diapason is multiple, because being twice composed, it makes a Multiple, viz. the Disdiapason pason; then he proves that Diapason is duple 2: 1. Thus, it cannot be any greater Multiple as 1: 3; for it is composed of Two superparticulars, viz. Diatessaron and Diapente: But 2: 16 is composed of the Two greatest superparticulars 3: 2 and 4: 3. Now if the Two greatest superparticulars make the least Multiple 2: 1, no other Two are equal to it, and far less to a greater; and the 8ve being multiple, and composed of Two superparticulars, must therefore be 2: 1. From this 'tis also concluded that Diatessaron is 4: 3, Diapente 3: 2, and Disdiapason 1: 4; and the rest are deduced from these.

Discords are either (Emmeli) concinnous, i. e. fit for Musick, which is by some also applied to Concords, or (Ecmeli) inconcinnous. Of the Concinnous they numbed these, viz. Diesis, Hemitonium, Tonus, Triemitonium, Ditonum. There are different Species of each; and of their Quantities we shall hear again.

THE simple Intervals are called Diastems, which are different according to the Genera, of which below; the Compound are called

Systems, of which next.

III. OF SYSTEMS. A System is an Interval composed, or conceived as composed, of several lesser. As there is no least Interval in the Nature of the Thing, so we can conceive any given Interval as composed of, or equal to the Sum of others; but here a System is an Interval which is actually divided in Practice; and where

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where along with the Extremes we conceive always fome intermediate Terms. As Systems are only a Species of Intervals, so they have all the same Distinctions, except that of Composite and Incomposite. They were also distinguished several other Ways not worth Pains to repeat. But there are Two we cannot pass over. which are these, viz. into concinnous and inconcinnous; the first composed of such Parts, and in fuch Order as is fit for Melody; the other is of an opposite Nature. Then into perfect and imperfect: Any System less than Disdiapason was reckoned imperfect; and that only called Perfett, because within its Extremes are contained Examples of the simple and original Concords, and in all the Variety of Order, in which their concinnous Part ought to be taken; which Differences constitute what they call'd the Species or Figure confonantiarum; which were also different according to the Genera: It was also called the Systema maximum, or immutatum, because they thought it was the greatest Extent, or Difference of Tune, that we can go in making good Melody; tho' fome added a 5th to the Disdiapason for the greatest System; and some suppose Three 8ves; but they all owned the Diapason to be the most perfect, with respect to the Agreement of its Extremes; and that however many 8ves we put in the Systema maximum, they must all be constituted or subdivided the same Way as the first: And therefore when we know how 8ve was divided, we know the Nature of their Diagramma, which we now call call the Scale of Musick; the Variety of which constitutes what they called the Genera melodia, which were also subdivided into Species; and

these must next be explained.

IV. OF the GENERA. By this Title is meant the various Ways of fubdividing the confonant Intervals (which are the chief Principles of Melody) into their concinnous Parts. As the Octave is the most perfect Interval, and all other Concords depend upon it; so according to the modern Theory we consider the Division of this Interval, as containing the true Division of the whole Scale: (See above Chap. 8.) But the Ancients went to work with this fomewhat differently: The Diatessaron or 4th was the least Interval they admitted as Concord; and therefore they fought first how that might be most concinnously divided; from which they constituted the Diapente or 5th, and Diapason or 8ve: Thus, the Sum of 4th and 5th is an Octave, and their Difference is a Tonus; if therefore to the same Fundamental, suppose a, we take a 4th b, 5th c, and 8ve d, then also b-d is a 5th, and c-d a 4th, and b: c is the Tonus; which they called particularly the Tonus dinzenctious, because it separates or stands in the Middle betwixt Two 4ths, one on either Hand, a - b, and c-d. This Tonus they reckoned indifpensable in rising to a 5th: And therefore, the Division of the 4th being made, the Addition of this Tone made the 5th; and adding another 4th, the same Way divided as the first, completed the 8ve. Now the Diatesaron being 23

as it were the Root or Foundation of their Scale, what they call'd the Genera arose from its various Divisions: Hence they defined the GENUS (modulandi) the manner of dividing the TETRACHORD, and disposing its four Sounds (as to their Succession:) And this Definition shews us in general, That the 4th was divided into 3 Intervals by two middle Terms, fo as to contain 4 Sounds betwixt the Extremes: Hence we have the Reason of the Name Diatessaron, (i. e. per quatuor;) and because from the 4th to the 5th was always the Tone, the 5th contained 5 Notes, and hence called Diapente (i. e, per quinque:) And with respect to the Lyra and its Strings, these Intervals were called Tetrachordum and Pentechordum. But the 8ve was called Diapason, (as it were per omnes) because it contains in a manner all the different Notes of Musick; for after one Octave all the rest of the Notes of the Scale were reckoned but as it were Repetitions of it: Yet with respect to the Lyre, it was also called Octochordum. The Disdiapason and all other Names of this Kind being now plain enough, need not be infifted on: And we shall proceed.

By universal Consent the Genera were Three, viz. the Enharmonick, Chromatick and Diatonick. The Reasons of these Names we shall have presently; but the two last were variously subdivided into different Species; and even the first, tho' 'tis commonly reckoned to be without any Species, yet different Authors proposed different

ferent Divisions, under that Name, tho' without distinguishing Names of Species, as were added to the other Two.

ARISTOXENUS who measured all by the Ear, expressed his Constitutions of the Genera in this Manner: He supposes the Tonus (diazeucticus) or Difference of the 4th and 5th, to be divided into 12 equal Parts; which, to prevent Fractions, Ptolomy, when he explains them, doubles, and makes 24; fo that the whole 4th must contain 60 of them. A certain Number of these imaginary Intervals he affigned to each of the Three Parts into which the 4th is to be divided; and all together made up these Six following Divisions, which I take with the common Latin Names.

| | | 4th |
|-----------|-----------|---------------------|
| Flanson & | | a-b-c-d. |
| Enharmon | nium | . 6+ 6+48=60 |
| | Molle | |
| | Hemiolion | |
| | Tonicum | |
| Diatonum | Molle | 12+18+30=60 |
| | Intensum | . 12 + 24 + 24 = 60 |

In the Enharmonium, suppose a, (marked at the Top of the Table) the first and lowest Note of the Tetrachord, from that to the 2d b, is 6 of the Parts mentioned; to the 3d c, is other 6, and from the 3d to the acutest Note d, is an Interval equal to 48 of these Parts: In this Manner you can explain all the rest. Six of them he called a Diesis Enharmonica; 8 a Diefis

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Diesis trientalis, 9 a Diesis quadrantalis, 12 a Hemitonium, 24 a Tonus, 36 a Triemitonium; and 48 a Ditonum; but to measure all these accurately by the Ear was an extravagant Pretence. Let us consider the Divisions that were made by Ratios.

Besides some particular Ratios of Archytas, Eratosthenes and Didymus, (who were all Musicians) which I pass by, Ptolomy gives us an Account of the following 8 Divisions of the Tetrachord; where the Fractions express the Ratio betwixt each Sound (marked by the Letters standing above) and the next, in order from a the lowest, i. e. suppose any of the lower Notes a, b or c to be 1. the Fraction betwixt that and the next expresses the Proportion of that next to it.

Diatesfaron. $\frac{45}{46} \times \frac{23}{24} \times \frac{4}{5} = \frac{3}{4}$ Enharmonium . $\frac{^{27}}{^{28}}$ X $\frac{^{14}}{^{15}}$ X $\frac{^{5}}{^{6}}$ = $\frac{^{3}}{^{4}}$ Chroma Antiquum $\frac{21}{22} \times \frac{11}{12} \times \frac{6}{7} = \frac{3}{4}$ Intensum Molle : Tonicum . Diatonum Ditonicum Pythagor. The Table continued K k 2

Diatonum
$$\left\{ \begin{array}{l} Intenfum \\ \text{or} \\ Syntonum \\ \text{Equabile.} \end{array} \right\} \begin{array}{l} \frac{15}{16} \times \frac{8}{9} \times \frac{9}{10} = \frac{3}{4} \\ \frac{11}{12} \times \frac{10}{11} \times \frac{9}{10} = \frac{3}{4} \end{array}$$

THESE different Species were also called the Colores (Chroai) generum : Molle expresses a Progression by small Intervals, as Intensium by greater; the other Names are plain enough. The Two first Intervals of the Enharmonium, are called each a Diesis; the Third is a Ditonum, and particularly the 3d g. already explained. The Two first of the Chromatick are called Hemitones, and the Third is Triemitonium; and in the Antiquum it is the 3d l. above explained. The first in the diatonick is called Hemitonium, and the other Two are Tones; particularly the 243 is called Limma (Pythagoricum;) 7 is the greatest of the Tones, and the least; but the 3 and 3 are the Tonus major and minor above explained.

As to the Names of the Genera themselves, the Enharm. was so called as by a general Name; or some say for its Excellence (tho' where that lies we don't well know.) The Diatonum, because the Tones prevail in it. The Chromatick was so called, say some, from $\chi po \alpha$ color, because as Colour is something betwixt Black and White, so the Chrom. is a medium be-

twixt the other Two.

But now to what Purpose all these Divisions were contrived, we cannot well learn by any Thing that they have told us. The Enbarm. was by all acknowledged to be fo difficult, that few could practife it, if indeed any ever could do it accurately; and they own much the fame of the Chromatick. Such Inequalities in the Degrees of the Scale, might be used for attacking the Fancy, and humouring fome diforderly Motions: But what true Melody could be made of them, we cannot conceive. All acknowledged, that the Diatonick was the true Melody which Nature had formed all Mens Ears to receive and be fatisfied with; and therefore it was the general Practice; tho' in their Speculations of the Proportions they had the Differences you fee in the Table. And tho' Diatonick was the prevailing Kind, yet still a Question remained among them, Whether it should be Aristoxenus's Diatonum intensum, or the Pythagorick, which Eratosthenes contended for: (But here observe, the Pythagoreans departed from their Principles, by admitting the Limma, which is neither multiple nor superparticular;) or what Ptolomy calls the Syntonum or intensium, which Didymus maintain'd. The Aristox. could give no Proof of theirs, because it was impossible for the Ear to determine the Difference accurately: The other Two might be tried and proven by the Canon harmonicus; but if they tuned by the Ear, they might dispute on without any Certainty of the Kind they followed. As to the Species we now Kk3 make

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make Use of, the same may be said; but I shall

confider it afterwards.

Now, these Parts of the Diatesfaron are what they called the Diastems of the several Genera, upon which their Differences depend: Which are called in the Enharm. the Diesis and Ditonum; in the Chromatick, the Hemitonium and Triemitonium; in the Diaton. the Hemitonium (or Limma) and the Tonus; but under these general Names, which distinguish the Genera, there are several different Intervals or Ratios, which constitute the colores generum, or Species of Enharm. Chrom. and Diatonick, as we have feen: And we are also to observe, that what is a Diastem in one genus is a System in another: But the Tonus diazeucticus 8:9 is essential in all the Kinds, not as a necessary Part of every Tetrachord, but necessary in every System of 8ve, to separate the 4th and 5th, or disjoin the feveral Tetrachords one from another.

Of the DIAGRAMMA or Scale.

ciples, of which the ancient Scale or Diagramma, which they called their Systema perfectium, was composed, in all its different Kinds. Let us now consider the Construction of it; in order to which I shall take the Tetrachords diatonically. I have already said, that the Extent of it is a Disdiapason, or Two 8ves in the Ra-

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tio 1:4: But in that Space they make Eighteen Chords, tho' they are not all different Sounds. And, to explain it, they represent to us Eighteen Chords or Strings of an Instrument, as the Lyre, supposed to be tuned according to the Proportions explained in any one Genus. each of these Chords (or Sounds) they gave a particular Name, taken from its Situation in the Diagramma, or also in the Lyre; which Names are commonly used by the Latins without They are these, Proslambanomeany Change. nos, Hypate-hypaton, parhypate-hypaton, Lichanos-hypaton, Hypate-mejon, parhypate-meson, Lichanos-meson, Mese, Trite-synemmenon, Paranete-synemmenon, Nete-synemmenon, Paramese, Trite-diezeugmenon, Paranete-diezeugmenon, Nete-diezeugmenon, Trite-hyperbolaon, Paranete-hyperbolæon, Nete-hyperbolæon.

THAT you may understand the Order and Constitution of their Scale and the Sense of these Names, take this short History of it. While the Lyre was Tetra. (or had but Four Strings) these were called in order from the gravest Sound Hypate, Parhypate, Paranete, Nete; which Names are taken from their Place in the Diagram, in which anciently they set the gravest uppermost, or their Situation in the Lyre, hence called Hypate, i. e. suprema, (Chorda, scil.) the next is parhypate, i. e. subsuprema or juxta upremam; then Paranete, i. e. penultima or juxta ultimam, and then Nete, i.e. ultima, as here.

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Hypate

J:
Parhypate

t:
Paranete

t:
Nete

This respects the ancient Lyra, whose Chords were dedicate to, or made symbolical of the Four Elements: Which according to some contained an 8ve, but some say only a Diatessaron 3: 4, and the Degrees I have marked by f for Semitone, and t for a Tone,

without Distinction.

Hypate

f.

Parhypate

t:
Lichanos

t:
Mefe

f:
Trite

t:
Paranete

t:
Nete

Next to this succeeded the Septichord Lyre of Mercury, which stands thus. Mese is media. Lichanos, so called from the digitus index with which the Chord was struck, as some say, or from its being the Index of the Genus, according to its Distance from Hypate; it was also called Hypermese, i. e. supra mediam. Trite so called as the Third from Nete; and it is also called Paramese, i. e. juxta mediam. This contains

Two Tetrachords conjunct in Mese, which is common to both, and are particularly called the Tetrachords Hypaton, and Neton; so that these which were formerly Names of single Chords, are now Names of whole Tetrachords; but as yet there was no great Necessity for the Distinction, as we shall see afterwards.

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Hypate

f:
Parhypate

t:
Lichanos

t:
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But Pythagoras finding the Imperfection of this System, added an 8th Chord to complete an 8ve: And this he did by feparating the Two Tetrachords by the Tonus diazeucticus; fo the Whole stood thus. Where we have Two Tetrachords, one from Hypate to Mese, and the other from Paramese to Nete; the Tonus diazeucticus coming betwixt them, i. e. betwixt Mese and Paramese. So here Paramese and Trite are different Chords, which were the fame before.

But there was another offichord Lyre attributed to Terpander; where instead of disjoining the Two Tetrachords of the septichord Lyre, he added another Chord a Tone lower than Hypate, called Hyper-hypate, i. e. super supremam, because it stood above in the Diagram; or Proslambanomenos, i. e. assumptus, because it belonged to none of the Two Tetrachords: The rest of the Names were unchanged.

OBSERVE, the feptichord Lyre was made fymbolical of the Seven Planets. Hypate represented Saturn, with respect to his periodical Revolution, which is slower than that of any of the rest, as the gravest Sounds are always produced by slowest Vibrations, and so of the

rest

rest gradually. But others make Nete represent Saturn with respect to his diurnal Motion round the Earth (in the old Astronomy) which is the swiftest, as the acutest Sounds are also produced by quickest Vibrations, and so of the rest. When the 8th Chord was added, it represented the

Calum stelliferum.

ded to the feptichord Lyre; which was either conjunct with it, making Ten Chords, or diffunct, making Eleven. The Conjunct was particularly distinguished by the Name Synemmenon, i. e. Tetrachordum conjunctarum; and the other by the Name of Diezeugmenon, i. e. disjunctarum. And now the middle Tetrachord was called Meson (mediarum;) and to the Words Hypate, Parhypate, Lichanos, Trite, Paranete, Nete, are now added the Name of the Tetrachord, which is necessary for Distinction; and the Whole stands thus,

| Tetra. | Hypate, hypaton. Parhypate, hyp. |
|--------------------|---|
| Hyp. | Parhypate, hyp. Lichanos, hyp. Hypate, meson, |
| Mef. | Parh, Mef. Lich. Mef. |
| -300023 | Mese Mese. Tonus Trite Syném. of Paramese diezeuct. Paranete, Syn. Trite Diezeug. |
| inia do Ligovia | Nete, Syn. Paranete Diezeug. Nete Diezeug. |

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AT length another Tetrachord was added, called Hyperbolaon (i. e. excellentium or excedentium) the acutest of all; which being conjunct with the Diezeugmenon, the Nete Diezeugmenon was its gravest Chord, the other Three being called Trite, Paranete, and Nete Hyperboleon; and now the Four Tetrachords Hypaton, Meson, Diezeugmenon, Hyperbolaon, made in all Fourteen Chords, to which, to complete the Disdiapason, a Proslambanomenos was added; all which with the Trite Paranete, and Nete Synemmenon make up the Eighteen Chords mentioned; which yet are but Sixteen different Sounds, for the Paranete Syn. coincides in the Trite Diez. as the Nete Syn. with the Paranete Diez. So that these Two differ only in the Trite Syn. and Paramese betwixt which there is a Semitone. And now fee the whole Diagram together in the following Page; where to favour the Imagination more, instead of marking the Tone and Semitone by f and t. the Chords that have a Tone betwixt them are fet further asunder than those that have a Semitone. At the fame Time I have annexed the Letters by which the modern Scale is above explained, that you may fee to what Part of that this ancient Scale corresponds. And because we place the gravest Notes in the lower Part of our Diagram (as the ancient Latins came at last to do, tho' they still applied Hypate to the gravest, and Nete to the acutest, to prevent Confusion) Ishall do it fo here. DIA

DIAGRAMMA VETERUM

aa Nete, Hyperbol. \ Tetrachor. g Paranete, Hyperbol. Hyperbolaon. f Trite, Hyberbol. e Nete, Diezeug. d Paranete Diezeug. S Nete, Synem. Diezeugmenon. Paranete, Syn. c Trite, Diezeug. b Paramefe. Trite, Synem. a Mefe. Mefe. G Lichanos, Meson, Meson. F. Parhypate, Meson, E Hypate, Meson. D Lichanos, bypaton. Hypaton. C Parbypate, bypaton. B Hypate, bypaton. A Proflambanomenos.

You see, that by twice applying Hypate, Parhypate and Lichanos; also Trite, Paranete and Nete Three Times; the Distinction of Tetrachords with these particular Names for the respective Chords, 'tis easily imagined in what Place of the Diagram any Chord stands. But if we consider every Tetrachord by it self, then we may apply these common Names to its Chords, viz. Hypate, Parhypate (or Trite) Licha-

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Lichanos (or Paranete) and Nete: And then when Two Tetrachords are conjunct, the Hypate of the one is the Nete of the other, as Hypate meson is equivalent to Nete hypaton; and in the Diagram, Mese is the Nete meson and the Hypate Synem. and Paramese is the Hypate diezeug. And lastly, Nete diezeug. is equal to Hypate hyperbolaon. We shall know the Use of the Tetrachord synemmenon, when we come to explain the Business of their Mutations. The Rest of the Diagram from Proslamban. is a concinnous Series, answering to the flat Series of the diatonick Genus, explained in the Ch. 8. and the Order from Parhypate hypaton contains the sharp Series above explained. Observe, tho' there are certain Systems, particularly distinguished as Tetrachords, yet we have Tetrachords (i. e. Intervals of Four Sounds) in other Parts of the Scale, that are true 4ths 3:4. Again, if to any true 4th a Tonus diazeug. is added, we have the Diapente, as from Proslamb. to Hypate meson.

I have explained the Diagram in the diatonick genus; but the same Names are applied to all the Three Genera; and according to the Differences of these, so are the Relations of the several Chords to one another. But since the Constitution of the Scale by Tetrachords is the same in all, and that the Genera differ only in the Ratios which the Two middle Chords of the Tetrachord bear to the Extremes; therefore these Extremes were called standing or immoveable Sounds (Exwites soni stantes) and all the middle

ones

ones were called moveable (ninted) foni mobiles) for to raise a Series from a given Fundamental or Proflambanomenos, the first and last Chord of each Tetrachord is invariably the same, or common to every Genus; but the middle Chords vary according to the Genus. So the Parhypate or Trite, Lichanos or Paranete of each Tetrachord is variable, and all the rest of the Chords

of the Diagram are invariable.

THE next Thing to be considered is, what they called the Figures or Species of the confonant Systems, viz. of the 4th, 5th and 8ve (for they extended this Speculation no further than the simple Concords.) The colores generum differed according to the Difference of the constituent Parts of the Diatesaron; but the figure or species consonantiarum differ only according to the Order and Polition of the concinnous Parts of the System: So that in the same Diagram (or Series) and under every Difference of Genus and Color, there are Differences of the Figura. Now, tho' of a certain Number of different constituent Parts, there will be a certain Number of different Politions or Combinations of the Whole; yet in every Genus there is a certain Diastem agreed upon to be the Characteristick; and according to the Position of this in the System, so are the different Figura reckoned; the Combinations proceeding from the Differences of the other Diastems being neglected in this Matter. Ptolomy makes the Characteristick of the Diate Saron, the Ratio of the Two acutest Chords in every Genus; and of

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of the Diapason, the Tonus diezeucticus: But Euclid reckons them otherwise, and applies the same Mark to 4th, and 5th and 8ve; thus in the Enharmonick the Ditonum is the Characteristick; in the Chromatick it is the Triemitonium; and in the Diatonick the Semitone. If we take Two conjunct Tetrachords, as from Hypate-hypaton to Mese, we shall find in that all the Figures of the Diatesfaron, which are only Three; for there are but Three Places of the Diatessaron in which the Characteristick can exist; there are Four Figures of the Diapente which are to be found in Two disjunct Tetrachords, betwixt Hypate-meson and Nete-diezeugmenon. The 8ve is composed of the 4th and 5th, and the Three Species of 4th joined to each of the Four Species of 5th, make in all 12 Species of 8ves; but we consider here only those Connections of 4th and 5th, that are actually in the System, which are only Seven, to be found from Proslambanomenos to Nete-hyperboleon, i. e. in the Compass of a Disdiapason. Pro-Jambanomenos being the lowest Chord of the first 8ve, and Lichanos-meson of the last 8ve; for Mese begins another Revolution of the Diapason, proceeding the same Way as from Proflambanomenos: And because this System of Disdiapason contains all the Species of the Concords it was called perfect. And observe, that in every 8ve Euclid's Characteristick occurs twice, and they are always afunder by Two and Three Dieses, or Hemitones, or Tones (according to the Genus) alternatively. What was the Order they thought

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shall see presently.

V. Of Tones or Modes. They took the Word Tone in four different Senses. 1. For a single Sound, as when they said the Lyra has Seven Tones, i. e. Notes. 2. For a certain Interval, as the Difference of the 4th and 5th. 3. For the Tension of the Voice, as when we say, One sings with an acute or a grave Voice. 4. For a certain System, as when they said, The Dorick or Lydian Mode, or Tone; which is the Sense to be particularly considered in this Place.

THIS is the Part of the ancient Harmonica which we wish they had explained more clearly to us; for it must be owned there is an unaccountable Difference among the Writers, in their Definitions, Divisions and Names of the Modes. As to the Definition, I find an Agreement in this, that a Mode, or Tone in this Sense, is a certain System or Constitution of Sounds; and they agree too, that an Octave with all its intermediate Sounds is fuch a Constitution: But the specifick Differences of them some place in the Manner of Division or Order of its concinnous Parts; and others place merely in the Tension of the Whole, i. e. as the whole Notes are acuter or graver, or stand higher and lower in the Scale of Musick, as Bryennius fays very expresly. Boethius has a very ambiguous Definition, he first tells us, that the Modes depend on the Seven different Species of the Diapason, which are alfo called Tropi; and thefe, fays he, are Con-Stitu-

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stitutiones in totis vocum ordinibus, vel gravitate vel acumine differentes. Again he tays, Constitutio est plenum veluti modulationis corpus, ex consonantiarum conjunctione consistens, quale est Diapason, &c. Has igitur constitutiones, si quis totas faciat acutiores, vel in gravius totas remittat secundum supradictas Diapason consonantia species, efficiet modos septem. This is indeed a very ambiguous Determination, for if they depend on the Species of 8ves, to what Purpose is the last Clause; and if they differ only by the Tenor or Place of the whole 80e, i. e. as 'tis taken at a higher or lower Pitch, what Need the Species of 8ves be at all brought in: His Meaning perhaps is only to fignity, that the different Orders or Species of 8ves ly in different Places, i. e. higher and lower in the Scale. Ptolomy makes them the same with the Species of Diapason; but at the same Time he speaks of their being at certain Distances from one another. Some contended for Thirteen, some for Fifteen Modes, which they placed at a Semitone's Distance from each other; but 'tis plain, these understood the Differences to be only in their Place or Distances one from another; and that there is one certain harmonious Species of Octave applied to all, viz. that Order which proceeds from Proflamb. of the Systema immutatum, or the A of the modern Syfem. Ptolomy argues, that if this be all, they may be infinite, the they must be limited for Use and Practice; but indeed the Generality deme them by the Species diapafon, and therefore

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fore make only Seven Modes; but to what they tend, and the true Use, is scarcely well explained, and we are left to guess and reason about it; I shall consider them upon both the Suppositions, and first as they are the Species of Octaves, and here I shall follow Ptolomy.

The Tones have no different Denominations from the Genera; and what's faid of themin one Genus is applicable to all; and I shall here take the diatonick. The System of Disdiapason already explained in the Diagram (coinciding with the Series from A of the modern Scale) is the Systema immutatum; which I shall, in what follows here, call the System without Distinction, The Seven Species of Octaves, as they proceed in Order from A.B.C.D.E.F.G. are the Seven Tones, which differ in their Modulations, i. e. in the Distances of the successive Sounds according to the fixt Ratios in the System. These Seven Ptolomy calls, The 1st, Dorick, the same with the System, or beginning in A or Proslamb. 2d, Hypo-lydian, beginning in and following the Order from B or Hyp-hyp. 3d, Hypophrygian, beginning at C or Parh-hy. 4th, Hypodorian at D. 5th, Mixolydian in E. 6th, Lydian in F. 7th, Phrygian in G. The last Three he takes in the Octaves above, for a Reason will presently appear. Now, every Mode being confidered by it felf as a distinct System, may have the Names Proflamb. hyp-hyp. &c. applied to it; for there fignify only in general the Politions of the Chords in any particular System, if they are so applied, he calls them the Positions; for at

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Example, the first Chord, or gravest Note of any Mode is called its Proflamb. positione, and so of the rest in Order. But again these are confidered as coinciding, or being unifon, with certain Chords of the System; and these Chords are called the potestates, with respect to that Mode; for Example, the Hypodorian begins in D, or Lichanos hypaton of the System, which therefore is the potestas of its Prostamb, as Hypmeson is the patestas of its hyp-hyp, and so of others, that is, these Two Chords coincide and differ only in Name; and we also say, that such a numerical Chord as Profl. positione of any Mode is fuch a Chord, as hyp-hyp. potestate, which is equivalent to faying, that hyp-hyp. of the System is the Potestas of the Proslamb, posttione of that Mode.

You're easily find what Chord of the System or Dorick Mode is the 2d, 3d, &c. Chord of any other Mode, by counting up from the Chord of the System in which that Mode begins. Or contrarily, to know what numerical Chord of any Mode corresponds to any Chord of the Syfem, count from this Chord to that in which the Mode begins, and you have the Number of the Chord; to which you may apply the Names Proflamb. &c. or a, b, &c. And the Chords of any Mode being thus named to you, you'll lolve the preceeding Problems eatieft, by finding what numerical Chord of the Mode, that is the Name of; for Example, to find what Chord of the Mode Hypodorian coincides with the Parhypate-meson of the System (or Dorick Mode)

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The Hypo-dor. Mode begins, or has its Proslamb, positione, in D or Lichanos-hyp. of the System, betwixt which and Parhy-mes. are Three Chords (inclusive) therefore the Thing fought is the Third Chord, or Parhyp-hyp. positione of the hyperdorian Mode. Again, to find what Chord of the System is the potestas of the Lychhyp or 4th Chord of the Hypo-phr. Mode. This begins in C or Parhyp-hyp. of the System, and the 4th above is Parhy-meson or F the Thing fought, But more univerfally, to find what Chord of any Mode corresponds to any Chord of any other Mode; you may eafily folve this by the Table Plate 2. Fig. 1. explained above in Chap. 11. 9 3. Thus, find in the Column of plain Letters, the Letters at which the Modes proposed begin, against which in the same Lines you must find the Letter a, which is the Proflamb. positione, or first Chord of these Modes; and then these respective Columns compared, flew what Chord of the one corresponds to any of the other. Observe also, that were it propofed to begin in any Chord of any Mode (i.e. at any Chord of the System, or Letter of the plain Scale) and make a Series proceeding from that, in the Order of any other Mode; we eafily know by this Table what Chords of the System mult be altered to effect this; for Example, to begin in e, (which is Hyp-meson of the System or dorick Mode, Proslamb. of the Phrygian Mode, &c.) if we would proceed from this in the Order of the Hypo-lydian, which begins at b of the System, we must find e in the Column of plain Letters, and

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and in the same Line find b; the Signature of the Letters of that Column where b stands, hews what Chords are to be changed: And by this Table you solve all these Problems, with a great deal more Ease, than by the long and perplext Schemes which some of the Ancients give us: But let us return.

PTOLOMY in Chap. 10. Lib. 2. proposes to have his Modes at these Distances, viz. tone, tone, limma, tone, tone, limma. The Hypodorian being set lowest, then Hypo-phr. Hypolyd. Dorick, Phrygian and Mixolydian, yet according to the System they won't stand at these Distances, nor in that Order. But in the next Chap. it appears that he means only to take them fo as their Mese-potestate (or these Chords of each which is the first of a Series similar to the Systema immutatum,) shall stand in that Order; and to this Purpose he makes the Dorick the Systema immut. and the Prost. of the rest in order as already mentioned; only he takes Mixolyd. Lyd. and Phryg. in the 8ve above, i.e. at Nete diez. Trite hyperbol. Paranhyperbol. whereby their Meses potestate stand in the Order mentioned; otherwise they had flood in an Order just reverse of their proslamb. positione. And now, if we would know at what Distances the Meses potestate of these Modes are let us find what numerical Chord of each Mode is its Mese potestate, and let it be exprest by the Letters applied positione, as already explained: Then we must suppose that from a of the System (or Dorick Mode) a Series proceeds in each of

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the Seven different Orders; and by the Table last mentioned, we shall know, in the Manner also explained, what Chords are to be altered for each; therefore taking these Chords that are the Meses potestate of each Mode, we shall see their mutual Distances. As Ptolomy has placed the Proslambanomenos, or a, positione of each Mode, their Meses potestate are in the Chords e: f*. g: a: b: c*. d. in order from Hypo-dor. as above mentioned, that is, when all the Orders are transferred to the Proflamb. of the Dorick Mode, the necessary Variety of Signatures causes the f and c to be marked * for the Hypo-phr. and Lydian Modes, and these fx and cx are the Meses potestate of these Modes; all the rest are plain; therefore the mutual Distances of these Meses potestate are expressed in the Scheme by (:) which signifies a Tone, (.) a Semitone or limma, which are different from what he had formerly proposed.

Doctor Wallis in explaining these by the modern System, chuses the Signature for the Lydian Mode, so that a (its Proslamb.) has a stat Sign, and the Mese-potestate of it is c plain: But since this explained is the only Sense according to which the Distances of these Meses-potestate can be found, and since 'tis more rational, that when any Mode is to be transferred to the Prosl-positione of another, that Prosl should not be altered; for otherwise it is transferred to another Note; therefore I was obliged to differ from the Doctor in that Particular: But neither does his Method set the Meses potestate at the Distances

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Distances which Ptolomy mentions, and which by Examination I find cannot possibly be done without changing the Prost. of the Systema immutatum.

ANCIENTLY there were but Three Modes, the Dorick, Lydian and Phrygian, so called from the Countries that used them, and particularly called Tones because they were at a Tone's Distance from each other, and afterwards the rest were added and named from their Relations to the former, particularly the Hypodorian, as being below the Dorian, and so of the rest; for which Reason tis by some placed fish, and they make its Proslambanomenos the lowest Sound that can be distinctly heard. But we should be easy about their Names or Order, if we understood the true Nature and Use of them.

If the Modes are indeed nothing else but the Seven Species of Octaves, the Use of them we can only conceive to be this, viz. That the Proft. of any Mode being made the principal Note of any Song, there may be different Species of Melody answering to these different Constitutions; but then we are not to conceive that the Proft. or Fundamental of any Mode is fixt to one particular Chord of the System, for Ex. the Phrygian to g; fo that we must always begin there, when we would have a Piece of Melody of that Species: When we fay in general that fuch a Mode begins in g, 'tis no more than to fignifie the Species of 8ve, according as they LIA appear

appear in a certain fixt System; but we may begin in any Chord of the System, and make it the Profl. of any Mode, by adding new Chords, or altering the Tuning of the old (in the Manner already mentioned:) If the Design is no more, but that a Song may be begun higher or lower, that may be done by beginning at the fame Chord, which is the Proft. of any Mode in the System, and altering the Tune of the Whole, keeping still the fixt Order (which as I have already faid, is that in our modern natural Scale from a) but it will be easier to begin in a Chord which is already higher or lower, and transfer the Mode in which the Song is, to that Chord. If every Song kept in one Mode, there was Need for no more than one diatonick Series, and by occasional changing the Tune of certain Chords, these Transpositions of every Mode to every Chord may be eafily performed; and I have fpoken already of the Way to find what Chords are to be altered in their tuning to effect this, by the various Signatures of * and 1: But if we suppose that in the Course of any Song a new Species is brought in, this can only be effected by having more Chords than in the fixt System, fo as from any Chord of that, any Order or Species of 8ve may be found.

Is this be the true Nature and Use of the Tones, I shall only observe here, that according to the Notions we have at present of the Principles and Rules of Melody, as they have been explained in some of the preceeding Chapters, most of these Modes are impersect, and inca-

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pable of good Melody; because they want some of those we reckon the essential and natural Notes of a true Mode (or Key) of which we reckon only Two Species, viz. that from c and a, or the Parhypate-hypaton and Proslambano-

menos of the ancient fixt System.

Again, if the essential Difference of the Modes consists only in the Gravity or Acuteness of the whole 8ve; then we must suppose there is one Species or concinnous Division of the 8ve, which being applied to all the Chords of the System, makes them true Fundamentals for a certain Series of faccessive Notes. These Applications may be made in the Manner already mentioned; by changing the Tune of certain Chords in some Cases; but more universally, by adding new Chords to the System, as the artificial or sharp and flat Notes of the modern Scale above explained. But in this Case, again, where we suppose they admitted only one concinnous Species, we must suppose it to be corresponding to the 8ve a, of what we call the natural Scale; because they all state the Order of the Systema immutatum in the Diagram, fo as it answers to that 8ve.

But what a simple Melody must have been produced by admitting only one concinnous Series, and that too wanting some useful and necessary Chords? We have above explained, that the flat Series, such as that beginning in a, has Two of its Chords that are variable, viz. the 6th and 7th, whereof sometimes the greater, sometimes the lesser is used; and therefore a

System that wants this Variety must be so far impersect: And what has been explained in Chap. 13. shews how impossible it is to make any good Modulation or Change from one Key to another, unless both the Species of sharp and flat Key be admitted in the System; which Experience and all the Reasonings in the preceeding Chapters demonstrate to be necessary.

Protomy has a Passage relating to the Modes, with which I shall end this Head, Lib. 2. Chap. 7. of the Mutations with respect to what they call Tones. He fays, these Mutations with respect to Tones was not introduced for the fake of acuter or graver Sounds, which might be produced by raising or lowering the whole Instrument or Voice, without any Change in the Song; but upon this Account, that the fame Voice beginning the fame Song now in a higher Note then in a lower, may make a Kind of Change of the Mode. This, to make any Senfe, must signify that the same Song might be contrived fo, as feveral Notes higher or lower might be used as Fundamentals to a certain Number of fuccessive Notes; and all together make one Song; like what I explained of our modern Songs making Cadences in different Notes, fo as the Song may be faid to begin there again. If this is not the Sense, then what he fays is plainly a Contradictions But this may be the true Use of the Tones, in either of the Hypotheses concerning their essential Differences. He fays in the Beginning of that Chap: " The Mutations which are made

by whole Systems, which we properly call " Tones, because these Differences consist in " Tension, are infinite with respect to Possibility, " as Sounds are, but actually and with respect " to Sense they are finite." All this feems plainly to put the Difference of the Tones only in the Acuteness or Gravity of the Whole, else how do their Differences consist in Tension, which fignifies a certain Tenor or Degree of Tune; and how can they be called infinite, if they depend on the different Constitutions of the 8ve. Yet ellewhere he argues, that they are no other than the Species of 8ves, and as fuch makes their Number Seven; and accordingly, in all his Schemes, fets down their different Modulations: But in Chap. 6. he feems more plainly to take in both these Differences, for he fays, there are Two principal Differences with respect to the Change of the Tone, one whereby the whole Song is fung higher or lower, the other wherein there is a Change of the Melody to another Species than it was begun in; but this he thinks is rather a Change of the Song or Melor than of the Tone, as if again he would have us think this depended only on the Acuteness and Gravity of the Whole; so obscurely has the best of all the ancient Writers delivered himself on this Article that deserved to have been most clearly handled. But that I may have done with it, I shall only fay, it must be taken in one of the Senses mentioned, if not in both, for another I think cannot be found. Let

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me also add, that the Moderns who have endeavoured to explain the ancient Musick take these Modes for the Species of 8ves. If you'll except Meibomius, who, in his Notes upon Aristides, affirms that the Differences of the Modes upon which all the different Effects depended, were only in the Tension or Acuteness and Gravity of the whole System. But there are Modes I call the Antiquo-modern Modes,

which shall be considered afterwards.

which makes what they called the Systema conjunctum, was added for joyning the upper and lower Diapason of the Systema immutatum; that when the Song having modulated thro Two conjunct Tetrachords, and being come to Mese, might for Variety pass either into the disjunct Tetrachord Diezeugmenon or the conjunct Synemmenon. Tis made in our System by b flat, i.e. putting only a Semitone betwixt a and b; so that from b to d (in 8ve,) makes Three conjunct Tetrachords; and the Use of that new Chord v with us is properly for perfecting some 8ve from whose Fundamental in the fixt Scale there is not a right concinnous Series.

VI. OF MUTATIONS. This signifies the Changes or Alterations that happen in the Order of the Sounds that compose the Melody. Aristox. says, 'tis as it were a certain Passon in the Order of the Melody. It properly belongs to the Melopaia to explain this, but is always put by it self as a distinct Part of the Harmonical

nica. These Changes are Four. I. In the Genus; when the Song begins in one as the Chromatick, and passes into another as the Diato-nick. 2. In the System, as when the Song passes out of one Tetrachord, as Meson, into another, as Diezeugmenon; or more generally, when it passes from a high Place of the Scale to a low, or contrarily, that is, the Whole is fung fometimes high, fometimes low; or rather, a Part of it is high, and a Part of it low. 3. In the Mode or Tone, as when the Song begins in one, as the Dorick, and passes into another, as the Lydian: What this Change of the Mode fignifies according to the modern Theory has been explained already. 4. In the Melopaia, that is, when the Song changes the very Air, fo as from gay and sprightly to become fost and languishing, or from a Manner that expresses one Passion or Subject to the Expression of some other; and therefore some of them call this a Change in the Manner (secundum morem): But to express Passion, or to have what they called Pathetick Musick, the various Rythmus is absolutely necessary to be join'd; and therefore among the Mutations fome place this of the Rythmus, as from Fambick to Choraick; but this belongs properly to the Rythmica. Now these are at best but mere Definitions, the Rules when and how to use these Changes, ought to be found in the Melopæia.

VII. OF the MELOPOEIA, or Art of making Melody or Songs. After the End and Principles of any Art are supposed to be distinctly

enough

enough shewn, the Thing to be expected is, that the Rules of Application be clearly fet forth. But in this, I must fay it, the Ancients have left us little else than a Parcel of Words and Names; fuch a Thing they call fuch a Name; but the Use of that Thing they leave you to find. The Substance of their Doctrine according to Euclid is this. After he has faid that the Melopaia is the Use of the Parts (or Principles) already explained. He tells us, it consists of Four Parts, first ayoyn, which the Latins called ductus, that is, when the Sounds or Notes proceed by continuous Degrees of the Scale, as a. b. c. 2d. πλοκή, nexus, which is, when the Sounds either ascending or descending are taken alternately, or not immediately next in the Scale, as a, c, b, d, or a, d, b, e, c, f, or these reversely d, b, c, a. 3d. πετ]εία, Petteia, (for the Latins made this Greek Name their own) when the same Note was frequently repeated together, as a, a, a. 4th, Tovn, Extensio, when any one Note was held out or founded remarkably longer than the rest. This is all Euclid teaches us about it. But Aristides Quintilianus, who writes more fully than any of them, explains the Melopaia otherwise. He calls it the Faculty or Art of making Songs, which has Three Parts, viz. Anyis, migis, xenois, which the Latins call sumtio, mistio, usus.

Not to trouble our selves with long Greek, Passages, I shall give you the Definitions of these in Meibomius's Words, 1. Sumtio est per quam musico datur a quali vocis loco Systema sit facis

faciendum, utrum ab Hypatoide an reliquorum aliquo. 2. MISTIO, per quam aut sonos inter se aut vocis locos coagmentamus, aut modulationis genera, aut modorum Systema. 3. Usus, certa quedam modulationis confectio, cujus species tres, viz. Ductus, Petteia, Nexus. As to the Definitions of the Three principal Parts, the Author of the Dictionaire de Musique puts this Sense upon them wis Sumtio teaches the Compofer in what System he ought to place his Song, whether high or low, and confequently in what Mode or Tone, and at what Note to begin and end. Mistio, says he, is properly what we call the Art of Modulating well, i.e. after having begun in a convenient Place, to profecute or conduct the Song, fo as the Voice be always in a convenient Tension; and that the essential Chords of the Mode be right placed and used, and that the Song be carried out of it, and return again agreeably. Usus teaches the Compofer how the Sounds ought to follow one another, and in what Situations each may and ought to be in, to make an agreeable Melody, or a good Modulation. For the Species of the Usus: Aristides defines the ductus and nexus the fame Way as Euclid does; and adds, that the ductus may be performed Three Ways, or is threefold, viz. ductus rectus, when the Notes ascend, as a, b, c; revertens, when they descend c, b, a; or circumcurrens, when having ascended by the Systema disjunctum, they immediately descend by the systema conjunctum, or move downwards betwixt the fame Extremes, 1R 344 A TREATISE CHAP. XIV.

in a different Order of the intermediate Degrees, as having afcended thus, a:b:c:d, the Defection is d:c:l/a, or c:d:e:f, and f:el/a, d:c. But the Petteia he defines, Qua cognofcimus quinam sonorum omittendi, & qui sunt adsumendi, tum quoties illorum singuli: porro a quonam incipiendum, & in quem definiendum; atque hac quoque morem exhibet. In short, according to this Definition the Petteia is the whole Art.

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THERE were also what they called, The modi melopaia, of which Aristides names these, Dithyrambick, Nomick, and Tragick; called Modes for their expressing the several Motions and Affections of the Mind. The best Notion we can form of this is, to suppose them something like what we call the different Stiles in Musick, as the Ecclesiastick, the Choraick, the Recitative, &c. But I think the Rythmus must have a considerable or the greatest Share in these Differences.

But now if you'll ask where are the particular practical Rules, that teach when and how all these Things are to be done and used, I must own, I have sound nothing of this Kind particular enough to give me a distinct Idea of their Practice in Melody. It is true, that Aristone-nus employs his whole 3d Book very near, in something that seems designed for Rules, in the right Conduct of Sounds for making Melody. But Truth is, all the tedious and perplext Work he makes of it, amounts to no more than shewing.

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ing, what general Limitations we are under, with respect to the placing of Intervals in Succession, according to the several Genera, and the Constitution of the Systema immutatum, or what we call the naturally concinnous Series. You'll understand it by One or Two Examples: First, in the Diatonick Kind, he says, That Two Semitones never follow other immediately, and that a Hemitone is not to be placed immediately above and below one Tone, but may be placed above and below Two or Three Tones: and that Two or Three Tones may be placed together but no more. Then as to the Two other Genera, to understand what he fays, obferve, that the lower Part, of the Tetrachord containing Two Dieses in the One, and Two Hemitones in the other Genus (whose Sums are always less than the remaining Ditone or Triemitone that makes up the Diatesaron) is called TURVOV spissum, because the Intervals being small, the Sounds are as it were fet thick and near other; opposite to which is amunyon non spissum or rarum: Notice too, that the Chords that belonged to the spissum were called munuoi, and particularly the lowest or gravest of the Three in every Tetrachord were called βαρυπυκνοι, (from βάρυς gravis,) the middle μεσόπυχνοι (from μετος medius) the acutest οξύπυκνοι (from οξύς acutus). Those that belonged not to the πυανον were called απυκνδι, extra spissum. Now then, with respect to the Enharmonick and Chromatick we are told, that Two Spissa, or Mm

Two Ditones, Triemitones, or Tones cannot be put together; but that a Ditone may stand betwixt Two spissa; that a Tone (it must be the diazeucticus betwixt Two Tetrachords) may be placed immediately above the Ditone or Triem. but not below, and below the Spissum but not above. There is a World more of this kind, that one sees at Sight almost in the Diagram, without long tedious Explications; and at best they are but very general Rules. There is a Heap of other Words and Names mentioned by several Authors, but not worth

mentioning.

Bur at last I must observe and own, That any Rules that can possibly be given about this Practice, are far too general, either to teach one to compose different Species of Melody, or to give a distinct Idea of the Practice of others; and that 'tis absolutely necessary for these Purposes that we have a Plenty of Examples in actual Compositions, which we have not of the Ancients. There is a natural Genius, without which no Rules are sufficient: And indeed what Rules can be given, when a very few general Principles are capable of fuch an infinite Application; therefore Practice and Experience must be the Rule; and for this Reason we find both among the Ancients and Moderns, fo very few, and these very general Rules for the Composition of Melody. Besides the Knowledge of the System, and what we call Modulation or keeping in and changing the Mode or Key; there are other general Principles that Nature teacheth

teacheth us, and which must be attended to, if we would produce good Effects, either for the Entertainment of the Fancy with the Variety we find so indispensable in our Pleasures, or for imitating Nature, and moving the Affections. These are, first, the different Species of Sounds abstract from the Acuteness, as Drums, Trumpets, Violins, Flutes, Voice, &c. which as they give different Sensations, so they are fit for expressing different Things, and raising or humouring different Passions; to which we may add the Differences of strong and weak, or loud and low Sounds. 2do. Tho' a Piece of Melody is strictly the same, whether it is performed by an acute or grave Voice; yet 'tis certain, That acute Sounds and grave, have different Effects; fo that the one is more applicable to some Subjects than the other; and we know that, in general, acute Sounds (which are owing to quicker Vibrations) have fomething more brisk and fprightly than the graver, which are better applied to the more calm Affections, or to fad and melancholy Subjects; but there is a great Variety betwixt the Extremes; and different Customs and Manners may also make a Difference: We find by Experience a lively Motion in our Blood and Nerves, under some Affections of Mind, as Joy and Gladness; and in the more boisterous Passions, as Anger, that Motion is still greater; but others are accompanied with more calm and flow Motions; and fince Bodies communicate their Motion, and the Effect is proportional to the Cause, we see a M m 2 natural

natural Reason of these different Effects of acute and grave Sounds. 3tio. The Effects of Melody have a great Dependence on the alternate Passage or Movement of the Sounds up and down, i. e. from acute to grave, and contrarily; or its continuing for less or more Time in one Place; but the Variety here is infinite; yet Experience teaches fome general Lessons; for Example, if a Man in the Middle of a Discourse turns angry, 'tis natural to raise his Voice; this therefore ought to be exprest by raising the Melody from grave to acute; and contrarily a finking of the Mind to Melancholy must be imitated by the falling of the Sounds; a more evenly State by a like Conduct of the Melody. Again, the taking of the Sounds by immediate Degrees, or alternatively, or repeating the same Note, and the moving by greater or leffer Intervals, have all their proper and different Effects: These, and their various Combinations, must all be under the Composer's Consideration; but who can possibly give Rules for the infinite Variety in the State and Temper of human Minds, and the proper Application of Sounds for expressing or exciting these? And when Compositions are designed only for Pleasure in general, what an infinite Number of Ways may this be produced?

MGAIN it must be minded, That the Rythmus is a very principal Thing in Musick, especially of the pathetick Kind; for 'tis this Variety of Movements in the quick or slow Successions, or Length and Shortness of Notes, that's

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the conspicuous Part of the Air, without which the other can produce but very weak Effects; and therefore most of the Ancients used to call the Rythmus the Male, and the Harmonica the Female. And as to this I must take Notice here, That the Ancients feem to have used none but the long and fhort Syllables of the Words and Verses which were fung, and always made a Part of their Musick; therefore the Rythmica was nothing with them but the Explication of the metrical Feer, and the various Kinds of Verses which were made of them: And for the Rythmopaia, or the Art of applying these, I am confident no Body will affirm they have left us any more than very general Hints, that can scarce be called Rules: The reading of Aristides and St. Augustin will, I believe, convince you of this; and all the rest put together have not faid as much about it. I suppose the ancient Writers, who in their Divisions of Musk,make the Rythmica one Part, and in their Explications of this speak of no other than that which belongs to the Words and Verses of their Songs, I fay these will be a sufficient Proof that they had no other. But you'll fee it further confirmed immediately, when we consider the ancient Notes or Writing of Musick. As to the modern Rythmus, I need fay little about it; that it is a Thing very different from the ancient, is manifest to any Body who considers what I have faid of theirs, and has but the mallest Acquaintance with our Musick. That he Measures and Modes of TIME explained M m 3

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in Ch. 12. and all the possible Subdivisions and Constitutions of them, are capable to afford an endless Variety of Rythmus, and express any Thing that the Motion of Sound is capable of, is equally certain to the experienced; and therefore I shall fay no more of it here: Only observe, That as I faid about the Harmonica, so of this 'tis certainly true, That the Rules are very general: We know that quick and flow Movements fuit different Objects; when we are gay and cheerful we love airy Motions; and to different Subects and Passions different Movements must be applied, for which Nature is our best Guide: Therefore the practical Writers leave us to our own Observations and Experience, to learn how to apply these Measures of Time, which they can only describe in general, as I have done, and refer us to Examples for perfecting our Idea of them, and what they are capable of.

Of the ancient Notes, and Writing of Musick.

We learn from Alipius (vid. Meibom. Edition.) how the Greeks marked their Sounds. They made use of the Letters of their Alphabet: And because they needed more Signs than there were Letters, they supplied that out of the same Alphabet; by making the same Letter express different Notes, as it was placed upright or reversed, or otherwise put out of the common Position; and also making them imperfect, by cutting off something, or by doubling some Strokes. For Example, the Letter Piexpresses.

expresses different Notes in all these Positions and we may know the whole Task, a Scholar had to learn, consider, that for every Mode there were 18 Signs (because they considered the Tetrachordum synemmenon, as if all its Chords had been really different from the Diezeugmenon) and for every one of the Three Genera they were also different; again the Signs that expressed the same Note were different for the Voice and for the Instruments. Alipius gives us the Signs for 15 different Modes, which with the Differences of the 3 Genera, and the Distinction betwixt Voice and Instrument, makes in all 1620; not that these are all different Characters, for the fame Character is used several Times, but then it has differerent Significations; for Example, in the diatonick Genus O is Lichanos hypaton of the Lydian Mode, and Hypate meson of the Phrygian, both for the Voice; fo that they are in effect as different Characters to a Learner. What a happy Contrivance this was for making the Practice of Musick easy, every Body will judge who confiders, that 15 Letters with some fmall Variation for the Chorda mobiles, in order to distinguish the Genera, was sufficient for all. In Boethius's Time the Romans were wife enough to ease themselves of this unnecesfary Difficulty; and therefore they made use only of the first 15 Letters of their Alphabet: But afterwards Pope Gregory the Great, confidering that the 8ve was the same in effect with the first, and that the Order of Degrees was the Mm4

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fame in the upper and lower 8ve of the Diagram, he introduced the Use of 7 Letters, which were repeated in a different Character. But hitherto there was no such Thing as any Mark of Time; these Characters expressing only the Degrees of Tune, which therefore were always

Degrees of *Tune*, which therefore were always placed in a Line, and the Words of the Song under them, fo that over every Syllable stood a Note to mark the Accent of the Voice: And for the *Time*, that was according to the long and short Syllable of the Verse; tho' in some very extraordinary Cases we hear of some particular Marks for altering the natural or ordi-

I shall end this Part with observing that among all the ancient Writers on Musick, there is not one Word to be found relating to Composition in Parts, or joining several different Melodies in one Harmony, as what we call Treble, Tenor, Bass, &c. But this shall be more particularly examined in the next Section.

nary Quantity.

FOR what Reasons the Greek Musicians made fuch a difficult Matter of their Notes and Signs we cannot guess, unless they did it designedly to make their Art mysterious, which is an odious Supposition; but one can scarcely think it was otherwise, who considers how obvious

^{§ 5.} Ashort HISTORY of the Improvements in MUSICK.

vious it was to find a more easy Method. This was therefore the first Thing the Latins corrected in the Greek Musick, as we have already heard was done by Boethius, and further

improved by Gregory the Great.

THE next Step in this Improvement is commonly ascribed to Guido Aretinus a Benedictin Monk, of Aretium in Tuscany, who, about the Year 1024, (tho' there are some Differences about the Year) contrived the Use of a Staff of 5 Lines, upon which, with its Spaces he marked his Notes, by fetting Points (.) up and down upon them, to denote the Rife and Fall of the Voice, (but as yet there were no different Marks of Time;) he marked each Line and Space at the Beginning of the Staff, with Gregory's 7 Letters, and when he spake of the Notes, he named them by these instead of the long Greek Names of Proflambanomenos, &c. The Correspondence of these Letters to the Names of the Chords in the Greek System being settled, fuch as I have already represented in their Diagram, the Degrees and Intervals betwixt any Line or Space, and any other were hereby understood. But this Artifice of Points and Lines was used before his Time, by whom invented is not known; and this we learn from Kircher, who fays he found in the Fefuites Library at Messima a Greek manuscript Book of Hymns, more than 700 Years old; in which fome Hymns were written on a Staff of 8 Lines, marked at the Beginning with 8 Greek Letters; the Notes or Points were fet upon the Lines, but no Use made

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made of the Spaces: Vincenzo Galileo confirms us also in this. But whether Guido knew this, is a Question; and tho' he did, yet it was well contrived to use the Spaces and Lines both, by which the Notes ly nearer other, sewer Lines are needful for any Interval, and the Distances of Notes are easier reckoned.

But there is yet more of Guido's Contrivance, which deferves to be confidered; First. He contrived the 6 musical Syllables, ut, re, mi, fa, fol, la, which he took out of this Latin

Hymn.

UT queant laxis RE sonare sibris MIra gestorum FAmuli tuorum, SOLve polluti LAbii redtum, O pater alme.

In repeating this it came into his Mind, by a Kind of divine Instinct fays Kircher, to apply these Syllables to his Notes of Musick: A wonderful Contrivance certainly for a divine Instinct! But let us fee where the Excellency of it lies; Kircher fays, by them alone he unfolded all the Nature of Musick, distinguished the Tones (or Modes) and the Seats of the Semitones: Elfewhere he fays, That by the Application of these Syllables he cultivated Musick, and made it fitter for Singing. In order to know how he applied them, there is another Piece of the History we must take along, viz. That finding the Greek Diagram of too small Extent, he added 5 more Chords or Notes in this Manner; having

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having applied the Letter A to the Proflambanomenos, and the rest in Order to Nete Hyperboleon, he added a Chord, a Tonus below Proslam. and called it Hypo-proslambanomenos, and after the Latins g. but commonly marked with the Greek Gamma I; to shew by this, fay fome, that the Greeks were the Inventors of Musick; but others say he meant to record himfelf (that Letter being the first in his Name) as the Improver of Musick; hence the Scale came to be called the Gamm. Above Nete Hyperbolaon he added other 4 Chords, which made a new disjunct Tetrachord, he called Hyper-hyperbolaon; so that his whole Scale contained 20 diatonick Notes, (for this was the only Genus now used) besides the b flat, which corresponded to the Trite Synemmenon of the Ancients, and made what was afterwards called the Series of b molle, as we shall hear.

Now the Application of these Syllables to the Scale was made thus: Betwixt mi and fa is a Semitone; ut: re, re: mi, fa: sol, and sol: la are Tones (without distinguishing greater and lesser;) then because there are but 6 Syllables, and 7 different Notes or Letters in the 8ve; therefore, to make mi and fa tall upon the true Places of the natural Semitones, ut was applied to different Letters, and the rest of the 6 in order to the others above; the Letters to which ut was applied are g.c. f. according to which he distinguished three Series, viz. that which begun with ut in g, and he called it the Series of b durum, because b was a whole Tone above

a; that which begun with ut in c was the Series of b natural, the same as the former; and when ut was in f, it was called b molle, wherein b was only a Semitone above a. See the whole Scale in the following Scheme, where ob-

GUIDO'S SCALE.

| n (ani | Bdur. | nat. | molle |
|----------------------------|---------|---------|--------|
| ee | 1 la | mi | ad at |
| dd | fol | re | la |
| CC | fa | ut | fol |
| 66 | mi | politar | OIL. |
| U | | 14.136 | fa |
| aa | re | la | mi |
| g f | ut | fol | re |
| a payme | 1- | fa | ut |
| e | la fol | mi | 1- |
| d | fa | re | fol |
| C H | mi | uı | 100 |
| 101 | Via NoV | 12 | fa |
| a | re | la | mi |
| Glaliv | out | fol | re |
| F | r int a | fa | ut |
| E on | no la | mi | bria i |
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| 1. 0 | re | ODB I | 1.30 |
| Tamm | ut | 2 8 | Troc. |

ferve, the Series of b natural stands betwixt the other two. and communicates with both; fo that to name the Chords of the Scale by thefe Syllables, if we would have the Semitones in their natural Places, viz. b.c, and e.f, then we apply ut to g, and after la, we go into the Series of b natural at fa, and after la of this, we return to the former at mi, and to on; or we may begin at ut in c, and pass into the first Series at mi, and then back to the otheratfa: By which Means the one Tranfition is a Semitone, viz. la .fa, and the other a Tone la : mi. To follow the Order of

b molie

b molle, we may begin with ut in c or f, and make Transitions the same Way as formerly: Hence came the barbarous Names of Gammut. Are, Bmi, &c. with which the Memories of Learners used to be oppressed. But now what a perplext Work is here, with fo many different Syllables applied to every Chord, and all for no other Purpose but marking the Places of the Semitones, which the simple Letters, a: b.c. &c. do as well and with infinite more Eafe. Afterwards fome contrived better, by making Seven Syllables, adding Si in the Blanks you fee in the Series betwixt la and ut, so that mi-fa and si-ut are the two natural Semitones: These 7 completing the 8ve, they took away the middle Series as of no Use, and so ut being in g or f, made the Series of B durum (or natural, which is all one) and B molle. But the English throw out both ut and fi, and make the other 5 ferve for all in the Manner explained in Chap. 11. where I have also shewn, the Unnecessariness of the Difficulty that the best of these Methods occasions. and therefore shall not repete it here. This wonderful Contrivance of Guido's 6 Syllables, is what a very ingenious Man thought fit to call Crux tenellorum ingeniorum; but he might have faid it of any of the Methods; for which Reason, I believe, they are laid aside with very many, and, I am fure, ought to be fo with every Body.

Bur to go one with Guido; the Letters he applied to his Lines and Spaces, were called Keys, and at first he marked every Line

and Space at the Beginning of a Staff with its Letter; afterwards marked only the Lines, as fome old Examples thew; and at last marked only one, which was therefore called the figned Clef; of which he diffinguished Three different ones, g, c, f; (the three Letters he had placed his ut in) and the Reason of this leads us to another Article of the History, viz. That Guido was the Inventor of Symphonetick Composition, (for if the Ancients had it, it was loft; but this shall be considered again) the first who joyned in one Harmony feveral distinct Melodies, and brought it even the length of 4 Parts, viz. Bass, Tenor, Counter, Treble; and therefore to determine the Places of the several Parts in the general System, and their Relations to one another, it was necessary to have 3 different figned Clefs (vid. Chap. 11.)

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HE is also said to be the Contriver of those Instruments they call Polyplettra, as Spinets and Harpsichords: However they may now difter in Shape, he contrived what is called the Abacus and the Palmula, that is, the Machinery by which the String is struck with a Plettrum made of Quills. Thus far go the Improvements of Guido Aretinus, and what is called the Guidonian System; to explain which he wrote

a Book he calls his Micrologum.

THE next confiderable Improvement was about 300 Years after Guido, relating to the Rythmus, and the Marks by which the Duration of every Note was known; for hitherto they had but imitated the Simplicity of the Ancients, and

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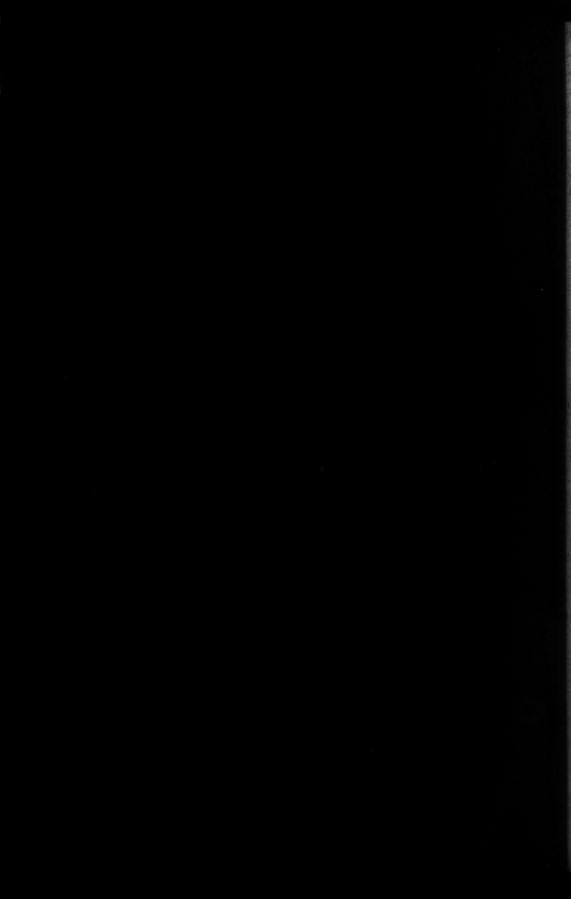
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and barely followed the Quantity of the Syllables, or perhaps not fo accurate in that, made all their Notes of equal Duration, as some of the old Ecclefiastick Musick is an Instance of. To produce all the Effects Musick is capable of, the Necessity of Notes of different Quantity was very obvious; for the Rythmus is the Soul of Musick; and because the natural Quantity of the Syllables was not thought fufficient for all the Variety of Movements, which we know to be fo agreeable in Musick, therefore about the Year 1330 or 1333, fays Kircher, the famous Joannes de Muris, Doctor at Paris, invented the different Figures of Notes, which express the Time, or Length of every Note, at least their true relative Proportions to one another; you fee their Names and Figures in Plate, 2 Fig. 3. as we commonly call them. But anciently they were called, Maxima, Longa, Brevis, Semibrevis, Minima, Semiminima, Chroma, (or Fusa) Semichroma. What we call the Demisemiquaver is of modern Addition. But whether all thefe were invented at once is not certain, nor is it probable they were; at first 'tis like they used only the Longa and Brevis, and the rest were added by Degrees. Now also was invented the Divition of every Song in separate and distinct Bars or Measures. Then for the Proportion of these Notes one to another it was not always the same; so a Long was in some Cases equal to Two Breves, fometimes to Three, and fo of others; and this Difference was marked generally at the Beginning; and fometimes by the Polition '

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Position or Way of joyning them together in the Middle of the Song; but this Variety happened only to the first Four. Again, respecting the mutual Proportions of the Notes, they had what they called Modes, Prolations and Times: The Two last were distinguished into Perfect and Imperfect; and the first into greater and lesser, and each of these into perfect and imperfect: But afterwards they reduced all into 4 Modes including the Prolations and Times. I could not think it worth Pains to make a tedious Description of all these, with their Marks or Signs, which you may fee in the already mentioned Dictionaire de Musique: I shall only observe here, That as we now make little Use of any Note above the Semibreve, because indeed the remaining 6 are fufficient for all Purpoles, so we have cast off that Difficulty of various and changeable Proportions betwixt the lame Notes: The Proportions of 3 to 1 and 2 to i was all they wanted, and how much more eafy and simple is it to have one Proportion fixt, viz. 2: 1 (i. e. a Large equal to Two Longs, and so on in Order) and if the Proportion of 3:1 betwixt Two fuccessive Notes is required, this is, without any Manner of Confusion or Difficulty, expressed by annexing a Point (.) on the Right Hand of the greatest of the Two Notes, as has been above explained; fo that 'tis almost a Wonder how the Elements of Musick were so long involved in these Perplexities, when a far easier Way of coming to the same End was not very hard to find.

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We shall observe here too, That till these Notes of various Time were invented, instrumental Performances without Song must have been very imperfect if they had any; and what a wonderful Variety of Entertainments we have by this Kind of Composition, I need not tell

you.

THERE remain Two other very confiderable Steps, before we come to the prefent State of the Scale of Musick. Guido first contrived the joyning different Parts in one Concert, as has been faid, yet he carried his System no fixther than 20 diatonick Notes: Now for the more simple and plain Compositions of the Ecclefiaftick Stile, which is probable was the most considerable Application he made of Musick. this Extent would afford no little Variety: But Experience has fince found it necessary to enlarge the System even to 34 diatonick Notes, which are represented in the foremost Range of Keys on the Breast of a Harpsichord; for so many are required to produce all that admirable Variety of Harmony, which the Parts in modern Compositions consist of, according to the many different Stiles practifed: But a more confiderable Defect of his System is, That except the Tone betwixt a and b, which is divided into Two Semitones by (flat) there was not another Tone in all the Scale divided; and without this the System is very imperfect, with refpect to fixt Sounds, because without these there can be no right Modulation or Change from Key

Key to Key, taking Mode or Key in the Sense which I have explained in Chap. 9. Therefore the modern System has in every 8ve 5 artistical. Chords or Notes which we mark by the Letters of the natural Chords, with the Distinction of w or 1, the Necessity and true Use of which has been largely explained in Chap. 8. and therefore not to be infifted on here; I shall only obferve, That by these additional Chords, we have the diatonick and chromatick Genera of the Ancients mixed; fo that Compositions may be made in either Kind, tho' we reckon the diatonick the true natural Species; and if at any Time, Two Semitones are placed immediately in Succession; for Example, if we sing c.c*.d, which is done for Variety, tho' feldom, fo far this is a Mixture of the Chromatick; but then to make it pure Chromatick, no fmaller Interval can be fung after Two Semitones ascending than a Triemitone, nor descending less than a Tone; because in the pure chromatick Scale the Spissum has always above it a Triemitone, and below it either a Triemitone or a Tone.

THE last Thing I shall consider here is, how the Modes were defined in these Days of Improvement; and I find they were generally characterized by the Species of 8ve after Ptolomy's Manner, and therefore reckoned in all 7. But afterwards they considered the harmonical and arithmetical Divisions of the 8ve, whereby it resolves into a 4th above a 5th, or a 5th above a 4th

5. of MUSICK. 562 a 4th. And from this they constituted 12 Modes, making of each 8ve two different Modes according to this different Division; but because there are Two of them that cannot be divided both Ways, therefore there are but 112 Modes. To be more particular, consider, in the natural System there are 7 different Octaves proceeding from these 7 Letters, a, b, c, d, e, f, g; each of which has Two middle Chords, which divide it harmonically and arithmetically, except f. which has not a true 4th, (because b is Three Tones above it, and a 4th is but Two Tones and a Semitone) and b, which confequently wants the true 5th (because f is only Two Tones and Two Semitones above it, and a true 5th contains 3 Times and a Semitone) therefore we have only 5 Octaves that are divided both Ways, viz. a, c, d, e, g, which make 10 Modes according to these different Divisions, and the other Two f and b make up the 12. These that are divided harmonically, i. e. with the 5ths lowest were called authentick, and the other plagal Modes. See the following Scheme.

To these Modes they gave the Names of the ancient Greek Tones, as Dorian, Phrygian: But several Authors differ in the Application of these Names, as they do about the Order, as, which they shall call the first and second, &c. which hang arbitrary Things, as far as I can understand, it were as idle to pretend to recon-

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|-------------------|------|------|
| 4th. | 5th. | 4th. |
| $\frac{g}{a} - c$ | g | C |
| b - e c - f | b | - e |
| d g e a | d | g |

cile them, as it was in them to differ about it. The material Point is, if we can find it, to know what they meant by these Distinctions, and what was the real Use of them in Musick; but even here where they ought to have agreed, we find

they differed. The best Account I amirable to give you of it is this: They considered that an 800 which wants a 4th or 5th, is imperfect; these being the Concords next to 8ve, the Song ought to touch these Chords most frequently and remarkably; and because their Concord is different, which makes the Melody different, they established by this Two Modes in every natural Octave, that had a true 4th and 5th: Then if the Song was carried as far as the Octave above, it was called a perfect Mode; if less, as to the 4th or 5th, it was imperfect; if it moved both above and below, it was called a mixt Mode: Thus some Authors speak about these Modes. Others confidering how indiffenfable a Chord the 5th is in every Mode, they took for the final or Key-note in the arithmetically divided Octaves, not the lowest Chord of that Octave, but that very 4th; for Example, the Octave g is arithmetically divided thus, g - c - g, c is a 4th above the lower g, and a 5th below the upper

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per g, this c therefore they made the final Chord of the Mode, which therefore properly speaking is c and not g; the only Difference then in this Method, betwixt the authentick and plagal Modes is, that the Authentick goes above its Final to the Octave, the other ascends a 5th, and descends a 4th, which will indeed be attended with different Effects, but the Mode is effentially the same, having the same Final to which all the Notes refer. We must next consider wherein the Modes of one Species, as Authentick or Plagal, differ among themselves: This is either by their standing higher or lower in the Scale, i. e. the different Tension of the whole Octave; or rather the different Subdivision of the Octave into its concinnous Degrees; there is not another. Let us confider then whether these Differences are sufficient to produce so very different Effects, as have been afcribed to them, for Example, one is faid to be proper for Mirth, another for Sadness, a Third proper to Religion, another for tender and amorous Subjects, and fo on: Whether we are to ascribe such Effects merely to the Constitution of the Octave, without Regard to other Differences and Ingredients in the Composition of Melody, I doubt any Body now a Days will be abfurd enough to affirm; these have their proper Differences, 'tis true, but which have lo little Influence, that by the various Combinations of other Causes, one of these Modes may be used to different Purposes. The greatelt and most influencing Difference is that of Nn3

these Octaves, which have the 3d l. or 3d g. making what is above called the sharp and flat Key: But we are to notice, that of all the 8ves, except c and a, none of them have all their essential Chords in just Proportion, unless we neglect the Difference of Tone greater and lester, and also allow the Semitone to stand next the Fundamental in fome flat Keys (which may be useful, and is fometimes used;) and when that is done, the Octaves that have a flat 3d will want the 6th g. and 7th g. which are very necessary on some Occasions; and therefore the artificial Notes * and 1 are of absolute Use to perfect the System. Again, if the Modes depend upon the Species of 8ves, how can they be more than 7? And as to this Distinction of authentick and plagal, I have shewn that it is imaginary, with respect to any essential Difference constituted hereby in the Kind of the Melody; for tho' the carrying the Song above or below the Final, may have a different Effect, yet this is to be numbred among the other Causes, and not ascribed to the Constitution of the Octaves. But 'tis particularly to be remarked, that these Authors who give us Examples in actual Compolition of their 12 Modes, frequently take in the artificial Notes * and 1 to perfect the Mebody of their Key; and by this Means depart from the Constitution of the 8ve, as it stands in the fixt natural System. So we can find little certain and confistent in their Way of speaking about these Things; and their Modes are all reducible to Two, viz. the sharp and flat; other

ther Differences respecting only the Place of the Scale where the Fundamental is taken: I conclude therefore that the true Theory of Modes is that explained in Chap. 9. where they are distinguished into Two Species, sharp and flat, whose Effects I own are different; but other Causes (vid. Pag. 547, &c.) must concur to any remarkable Effect; and therefore 'tis unreasonable to talk as if all were owing to any one Thing. Before I have done there is another. Thing you are to be informed of, viz. That what they called the Series of b molle, was no more than this, That because the 8ve f had a 4th above at b, excessive by a Semitone, and confequently the 8ve b had a 5th above as much deficient, therefore this artificial Note b flat or 1, ferved them to transpose their Modes to the Distance of a 4th or 5th, above or below; for taking l a Semitone above a, the rest keeping their Ratios already fixt, the Series proceeding from c with b natural (i.e. a Tone above a) is in the same Order of Degrees, as that from f with b flat (i. e, b a Semitone above a_i) but f is a 4th above c_i or a 5th below; therefore to transpose from the Series of b natural to b molle we afcend a 4th or defcend a 5th; and contrarily from b molle to the other: This is the whole Mystery; but they never speak of the other Transpolitions that may be made by other artificial Notes.

You may also observe, that what they called the Ecclesiastick Tones, are no other than cer-N n 4 tain

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tain Notes in the Organ which are made the Final or Fundamental of the Hymns; and as Modes they differ, some by their Place in the Scale, others by the sharp and flat 3d; but even here every Author speaks not the same Way: 'Tis enough we know they can differ no other Way, or at least all their Differences can be reduced to these. At first they were Four in Number, whose Finals were d, e, f, g constituted authentically: This Choice, we are told, was first made by St. Ambrose Bishop of Milan; and for being thus chosen and approven, they pretend the Name Authentick was added: Afterwards Gregory the Great added Four Plagals a, b, c, d, whose Finals are the very same with the first Four, and in effect are only a Continuation of these to the 4th below; and for this Connection with them were called plagal, tho' the Derivation of the Word is not fo plain,

But 'tis Time to have done; for I think I have shewn you the principal Steps of the Improvement of the System of Musick, to the present State of it, as that is more largely explained in the preceeding Chapters. I have only one Word to add, that in Guido's Time and long after, they supposed the Division of the Tetrachord to be Ptolomy's Diatonum diatonicum, i. e. Two Tones 8:9, and a limma [243]; till Zarlinus explained and demonstrated, that it ought to be the intensum, containing the Tone greater 8:9, lesser 9:10, and Semitone 15:16; which Kepler strongly argues for; as he also shews

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\$ 6. shews how inconsistently they spake about the Modes, where he reduces all to the Two Species of sharp and flat. 'Tis true, Galileo approves the other, as common Practice shewed that the Difference was infensible; yet it must be meant only with respect to common Practice. I have already explained how this Difference in fixt Instruments is the very Reason of their Imperfection after the greatest Pains to correct them; and how the natural Voice will, without any Direction, and even without perceiving it, choose fometimes a greater, fometimes a lesser Tone: Therefore I think Nature guides us to the Choice of this Species: If the commensurate Ratios of Vibrations are the Cause of Concord then certainly 4:5 is better than 64:81. The first arises from the Application of a simple general Rule upon which the more perfect Concords depend; the other comes in as it were arbitrarily. How the Proportions happen upon Instruments depends upon the Method of tuning them; of which enough has been already faid.

6. The ancient and modern Musick compared.

HE last Age was famous for the War that was raifed, and eagerly maintain'd by two different Parties, concerning the ancient and modern Genius and Learning. Among the disputed Points Musick was one. I know of nothing

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thing new to be advanced on either Side; fo that I might refer you to those who have examined the Question already: But that nothing in my Power may be wanting to make this Work more acceptable, I shall put the Substance of that Controversy into the best Form I can, and shall endeavour to be at the same Time

fort and distinct.

THE Question in general is, Whether the Ancients or the Moderns best understood and practifed Musick? Some affirm that the ancient Art of Musick is quite lost, among other valuable Things of Antiquity, vid. Pancirollus, de Musica. Others pretend, That the true Science of Harmony is arrived to much greater Perfection than what was known or practifed among the Ancients. The Fault with many of the Contenders on this Point is, that they fight at long Weapons; I mean they keep the Argument in generals, by which they make little more of it than some innocent Harangues and Flourishes of Rhetorick, or at most make bold Assertions upon the Authority of some misapplied Expressions and incredible Stories of ancient Writers, for I'm now speaking chiefly of the Patrons of the ancient Musick.

IF Sir William Temple was indeed ferious, and had any Thing else in his View, but to shew how he could declaim, he is a notable Instance of this. Says he, "What are become of the Charms of Musick, by which Men and Beasts were so frequently inchanted,

" and their very Natures changed, by which " the Passions of Men were raised to the greatest " Height and Violence, and then as fuddenly " appealed, fo as they might be justly faid, to " be turned into Lions or Lambs, into Wolves " or into Harts, by the Power and Charms of " this admirable Art?" And he might have added too, by which the Trees and Stones were animated; in Spite of the Sense which Horace puts upon the Stories of Orpheus and Amphion. But this Question shall be considered presently. Again he fays, "Tis agreed by the Learned, that "the Science of Musick, so admired of the "Ancients, is wholly loft in the World, and " and that what we have now, is made up out " of certain Notes that fell into the Fancy or " Observation of a poor Friar, in chanting his " Mattins. So that those Two divine Excel-" lencies of Musick and Poetry, are grown in a " Manner, but the one Fiddling and the other " Rhyming, and are indeed very worthy the Ig-" norance of the Friar, and the Barbarousness " of the Goths that introduced them among us." Some learned Men indeed have faid fo; but as learned have faid otherwise: And for the Defcription Sir William gives of the modern Mufick, it is the poorest Thing ever was said, and demonstrates the Author's utter Ignorance of Musick; Did he know what Use Guido made of these Notes? He means the Syllables, ut. re, mi, Gc. for these are the Notes he invented. If the modern Musick falls short of the ancient,

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Materials and Principles of Harmony are the fame Thing, or rather they are improven; for Guido's Scale to which he applied these Syllables, is the ancient Greek Scale only carried to a greater Extent; and which is much improven fince.

As I have stated the Question, we are first to compare the Principles and then the Practice. As to the Principles I have already explained them pretty largely, at least as far as they have come to our Knowledge, by the Writings on this Subject that have escaped the Wrack of Time. Nor is there any great Reason to suspect that the best are lost, or that what we have are but Sketches of their Writings: For we have not a few Authors of them, and these written at different Times; and some of them at good Length; and by their Introductions they propose to handle the Subject in all its Parts and Extent, and have actually treated of them all.

MEIBOMIUS, no Enemy to the ancient Cause, speaking of Aristides, calls him, Incomparabilis antiqua musica Auctor, & vere exemplar unicum, who, he says, has taught and explained all that was ever known or taught before him, in all the Parts' We have Aristoneous; and for what was written before him, he affirms to have been very deficient: Nor do the later Writers ever complain of the Loss of any valuable Author that was before them.

Now I suppose it will be manifest to the unprejudiced, who consider what has been explained

plained both of the ancient and modern Principles and Theory of Harmonicks, that they have not known more of it than we do, plainly because we know all theirs; and that we have improven upon their Foundation, will be as plain from the Accounts I have given of both, and the Comparison I have drawn all along in explaining the ancient Theory; therefore I need insist no more upon this Part. The great Dif-

pute is about the Practice.

To understand the ancient Practice of Mufick, we are first to consider what the Name fignified with them. I have already explained its various Significations; and shewn, that in the most particular Sense, Musick included these Three Things, Harmony, Rythmus and Verfe: If there needs any Thing to be added, take thefe few Authorities. In Plato's first Alcibiades, Socrates asks what he calls that Art which teaches to fing, play on the Harp, and dance? and makes him Answer, Musick: But singing among them was never without Verse. This is again confirmed by Plutarch, who fays, "That in "judging of the Parts of Musick, Reason and "Sense must be employed; for these three " must always meet in our Hearing, viz. Sound, " whereby we perceive Harmony; Time, " whereby we perceive Rythmus; and Letters " or Syllables, by which we understand what " is faid." Therefore we reasonably conclude, that their Musick consisted of Verses sung by one or more Voices, alternately, or in Choirs; fome574 A TREATISE CHAP. XIV.

times with the Sound of Instruments, and sometimes by Voices only; and whether they had any Musick without Singing, shall be again considered.

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LET us now consider what Idea their Writers give us of the practical Musick: I don't speak of the Effects, which shall be examined again, but of the practical Art. This we may expect, if 'tis to be found at all, from the Authors who write ex professo upon Musick, and pretend to explain it in all its Parts. I have already shewn, that they make the musical Faculties (as they call them) these, viz. Melopæia, Rythmopæia, and Poefis. For the First, to make the Comparison right, I shall consider it under these Two Heads, Melody and Symphony, and begin with the last. I have observed, in explaining the Principles of the ancient Melopaia, that it contains nothing but what relates to the Conduct of a fingle Voice, or making what we call Melody: There is not the least Word of the Concert or Harmony of Parts; from which there is very great Reason to conclude, that this was no Part of the ancient Practice, and is altogether a modern Invention, and a noble one too; the first Rudiments of which I have already faid we ow to that fame poor Friar (as Sir William Temple calls him) Guido Aretinus. But that there be no Difference about mere Words, observe, that the Question is not, Whether the Ancients ever joyned more Voices or Instruments together in one Symphony; but, whether feveral Voices were joyned, fo as each had Y

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had a distinct and proper Melody, which made among them a Succession of various Concords; and were not in every Note Unisons, or at the fame Distance from each other, as 8 ves? which last will agree to the general Signification of the Word Symphonia; yet'tis plain, that in fuch Cases there is but one Song, and all the Voices perform the same individual Melody; but when the Parts differ, not by the Tension of the Whole, but by the different Relations of the successive Notes, This is the modern Art that requires fo peculiar a Genius, and good Judgment, in which therefore 'tis fo difficult to fucceed well. The ancient Harmonick Writers, in their Rules and Explications of the Melopaia, speak nothing of this Art: They tell us, that the Melopaia is the Art of making Songs; or more generally, that it is the Use of all the Parts and Principles that are the Subjects of harmonical Contemplation. Now is it at all probable, that fo considerable an Use of these Principles was known among the Ancients, and yet never once mentioned by those who professed to write of Mufick in all its Parts? Shall we think these concealed it, because they envied Posterity so valuable an Art? Or, was it the Difficulty of explaining it that made them filent? They might at least have faid there was such an Art; the Definition of it is easy enough: Is it like the rest of their Conduct to neglect any Thing that might redound in any Degree to their own Praise and Glory? Since we find no Notice of this

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Art under the Melopæia, I think we cannot expect it in any other Part. If any Body should think to find it in the Part that treats of Systems, because that expresses a Composition of feveral Things, they'll be disappointed: For these Authors have confidered Systems only as greater Intervals betwixt whose Extremes other Notes are placed, dividing them into leffer Intervals, in fuch Manner as a fingle Voice may pass agreeably from the one Extreme to the other. But in distinguishing Systems they tell us, some are σύμφωνα some διάφωνα, i. e. some consonant fome dissonant: Which Names expressed the Quality of these Systems, viz. that of the first, the Extremes are fit to be heard together, and the other not; and if they were not used in Confonance, may fome fay, these Names are wrong applied: But tho' they fignified that Quality, it will not prove they were used in Confonance, at least in the modern Way: Besides, when they speak plainly and expresly of their Use in Succession or Melody, they use the fame Names, to fignify their Agreement: And if they were used in Consonance in the Manner described, why have we not at least some general Rules to guide us in the Practice? Or rather, does not their Silence in this demonstrate there was no fuch Practice? But tho' there is nothing to be found in those who have written more fully and expresly on Musick, yet the Advocates for the ancient Musick find Demonstration enough, they think, in some Passages of Authors that have given transient Descriptions of Musick: But

But if these Passages are capable of any other good Sense than they put upon them, I think the Silence of the professed Writers on Musick will undoubtedly cast the Balance on that Side. To do all Justice to the Argument, I shall produce the principal and fullest of these Kind of Passages in their Authors Words. Aristotle in his Treatife concerning the World, TEPI NOTHE, Lib. 5. answers that Question, If the World is made of contrary Principles, how comes it that it is not long ago dissolved? He shews that the Beauty and Pertection of it confifts in the admirable Mixture and Temperament of different Things. and among his Illustrations brings in Musick thus, Μεσική δε όξεις άμα και βαρείς, μακρύς τε και βραχείς Φθόγίες μίξασα, έν διαφόραις Φωναίς, μίαν ἀπετέλεσεν ἀρμονίαν, which the Translators pultly render thus, Musica acutis & gravibus sonis, longisque & brevibus una permixtis in diversis vocibus, unum ex illis toncentum red-dit, i. e. Musick, by a Mixture of acute and grave, also of long and short Sounds of different Voices, yields one absolute or perfect Concert. Again, in Lib. 6. explaining the Harmony of the celestial Motions, where each Orb, says he, has its own proper Motion, yet all tend to one harmonious End, as they also proceed from one Principle, making a Choir in the Heavens by their Concord, and he carries on the Compaisson with Musick thus: Καθαπέρ δε έν χορώ κουραίε καταρξάντες, συνεπηχεί πας δ χορός άνορων έθ ότε και γυναικων εν διαφόραις Φωναϊς όξυ-πέραις και βαρυτέραις μιαν άρμονίαν έμμελη κεραν-אטאדשא.

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νύντων. Quemadmodum fit in Choro, ut auspicianti presuli aut precentori, accinat omnis chorus, e viris interdum fæminisque compositus, qui diversis ipsis vocibus, gravibus scilicet & acutis concentum attemperant. i. e. As in a Choir, after the Pracentor the whole Choir fings, composed fometimes of Men and Women, who by the different Acuteness and Gravity of their

Voices, make one concinnous Harmony.

LET Seneca appear next, Epistle 84. Non vides quam multorum vocibus Chorus constet? Unus tamen ex omnibus sonus redditur, aliquaillic acuta est, aliqua gravis, aliqua media. Accedunt viris famina, interponuntur tibia, singulorum latent voces, omnium apparent. i.e. Don't you fee of how many Voices the Chorus confifts? yet they make but one Sound: In it fome are acute, some grave, and some middle: men are joyned with Men, and Whiftles also put in among them: Each fingle Voice is concealed, yet the Whole is manifest.

CASSIODORUS says, Symphonia est temperamentum sonitus gravis ad acutum, vel acuti ad gravem, modulamen efficiens, sive in voce sive in percussione, sive in flatu, i. e. Symphony is an Adjustment of a grave Sound to an acute, or

an acute to a grave, making Melody.

Now the most that can be made of these Passages is, That the Ancients used Choirs of several Voices differing in Acuteness and Gravity; which was never denied: But the Whole of these Definitions will be fully answered, suppoling

posing they sung all the same Part or Song only in different Tensions, as 8ve in every Note. And from what was premised I think there is Reason to believe this to be the only true Mean-

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But there are other considerable Things to he faid that will put this Question beyond all reasonable Doubt. The Word Harmonia signifies more generally the Agreement of feveral Things that make up one Whole; but fo do feveral Sounds in Succession make up one Song, which is in a very proper Sense a Composition. And in this Sense we have in Plato and others several Comparisons to the Harmony of Sounds in Mustck. But 'tis also used in the strict Sense for Confonance, and fo is equivalent to the Word Symphonia. Now we shall make Aristotle clear his own Meaning in the Passages adduced: He uses Symphonia to express Two Kinds of Consonance; the one, which he calls by the general Name Symphonia, is the Confonance of Two Voices that are in every Note unison, and the other, which he calls Antiphonia, of Two Voices that are in every Note 8ve: In his Problems, § 19. Prob. 16. He asks why Symphonia is not as agreeable as Antiphonia; and answers, because in Symphonia the one Voice being altogether like or as One with the other, they eclipse one another. The Symphoni here plainly must fignify Unifons, and he explains it eliewhere by calling them Omophani: And that the ove is the Antiphoni is plain, for it was a common Name to 800; and Aristotle himself explains 0 0 2

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explains the Antiphoni by the Voice of a Boy and a Man that are as Nete and Hypate, which were 8ve in Pythagoras's Lyre. Again, I own he is not speaking here of Unison and 8ve simply confidered, but as used in Song : And tho' in modern Symphonies it is also true, that Unison cannot be so frequently used with as good Effect as 8ve, yet his Meaning is plainly this, viz. that when Two Voices fing together one Song, 'tis more agreeable that they be 8ve than unifon with one another, in every Note: This I prove from the 17th Probl. in which he asks why Diapente and Diatesaron are never sung as the Antiphoni? He answers, because the Antiphoni, or Sounds of 8ve, are in a Manner both the same and different Voices; and by this Likeness, where at the same Time each keeps its own distinct Character, we are better pleased: Therefore he affirms, that the 8ve only can be fung in Symphony (διά πασών συμφωνία μόνη άδεται.) Now that by this he means fuch a Symphony as I have explained, is certain, because in modern Counterpoint the 4th, and especially the 5th are indispensable; and indeed the 5th with its Two 3ds, are the Lifeof the Whole. Again, in Probl. 18. he asks why why the Diapajon only is magadifed? And anfwers, because its Terms are the only Autiphoni: Now that this fignifies a Manner of Singing, where the Sounds are in every Note 8ve to one another, is plain from this Word magadifed, taken from the Name of an Instrument μαγάdies, in which Two Strings were always struck toge-

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together for one Note. Athenaus makes the Magadis the same with the Barbiton and Pectis; and Horace makes the Muse Polyhymnia the Inventor of the Barbiton. - Nec Po-Whymnia Lesboum refugit tendere Barbiton .-And from the Nature of this Instument, that it had Two Strings to every Note, some think it probable the Name Polyhymnia was deduced. Atheneus reports from Anacreon, that the Magadis had Twenty Chords; which is a Number fufficient to make us allow they were doubled; fo that it had in all Ten Notes: Now anciently they had but Three Tones or Modes, and each extended only to an 8ve, and being a Tone afunder, required precifely Ten Chords; therefore Athenaus corrects Possidonius for faying the Twenty Chords were all distinct Notes, and necessary for the Three Modes. But he further confirms this Point by a Citation from the Comick Poet Alexandrides, who takes a Comparison from the Magadis, and says, I am, like the Magadis, about to make you understand a Thing that is at the same Time both sublime and low; which proves that Two Strings were fruck together, and that they were not unifon. He reports also the Opinion of the Poet Fon, that the Magadis confifted of Two Flutes, which were both founded together, From all this 'tis plain, That by magadifed, Aristotle means such a Consonance of Sounds as to be in every Note at the same Distance, and consequently to be without Symphony and Parts according to the modern Practice. Atheneus reports also 003

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of Pindar, that he called the Musick fung by a Boy and a Man Magadis; because they fung together the same Song in Two Modes. Perault concludes from this, that the Strings of the Magadis were sometimes 3ds, because Aristotle says, the 4th and 5th are never magadifed: But why may not Pindar mean that they were at an 8ve's Distance; for certainly Aristotle used that Comparison of a Boy and a Man to express an 8ve: Mr. Perault thinks it must be a 3d because of the Word Mode, whereof anciently there were but Three; and confirms it by a Passage out of Horace, Epod. 9. Sonante mistum tibiis carmen lyra; hac Dorium illis Barbarum: By the Barbarum, fays he, is to be understood the Lydian, which was a Ditone above the Dorian: But the Difficulty is, that the Ancients reckoned the Ditone at best a concinnous Discord; and therefore 'tis not probable they would use it in so remarkable a Manner: But we have enough of this. The Author last named observes, that the Ancients probably had a Kind of simple Harmony, in which Two or Three Notes were tuned to the principal Chords of the Key, and accompanied the Song. This he thinks probable from the Name of an Instrument Pandora that Athenaus mentions; which is likely the same with the Mandora, an Instrument not very long ago used, says he, in which there were Four Strings, whereof one served for the Song, and was struck by a Plectrum or Quill tied to the Forefinger: The other Three were tuned

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fo as Two of them were an 8ve, and the other a Middle dividing the 8ve into a 4th and 5th: They were struck by the Thumb, and this regulated by the Rythmus or Measure of the Song, i. e. Four Strokes for every Measure of common Time, and Three for Triple. He thinks Horace points out the Manner of this Instrument in Ode 6. Lesbium fervate pedem, meique pollicis istum, which he thus translates. Take Notice, you who would joyn your Voice to the Sound of my Lyre, that the Measure of my Song is Sapphick, which the striking of my Thumb marks out to you. This Instrument is parallel

to our common Bagpipe.

THE Pallages of Aristotle being thus cleared, I think Seneca and Caffiodorus may be easily given ap. Seneca speaks of vox media, as well as acuta and gravis; but this can fignify nothing, but that there might be Two 8ves, one betwixt the Men and Women, and the shrill Tibia might be &ve above the Women: But then the latter Part of what he fays destroys their Cause; for singulorum voces latent can very well be faid of fuch as fing the same Melody Unifon or Octave, but would by no Means be true of feveral Voices performing a modern Symphony, where every Part is conspicuous, with a perfect Harmony in the Whole, For Cassiodorus, I think what he fays has no Relation to Confonance, and therefore I have translated it, An Adjustment of a grave Sound to an acute, or an acute to a grave making Melody: If it be alledged that temperamentum may signifie a Mixture, I shall 004

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yield it; but then he ought to have faid, Temperamentum sonitus gravis & acuti; for what means sonitus gravis ad acutum, and again acuti ad gravem? But in the other Case this is well enough, for he means, That Melody may confift either in a Progress from acute to grave, or contrarily : And then the Word Modulamen was never applied any other way than to fuccessive Sounds. There is another Passage which If. Vollius cites from Elian the Platonick. Συμφωνία δε έςι δυοίν ή πλειόνων Φθόγ Γων δζύτηλι και βαρύτητι διαφερόν ων κατα το αυτό πίωσις και κράσις, i. e. Symphony consists of Two or more Sounds differing in Acuteness and Gravity, with the same Cadence and Temperament: But this rather adds another Proof that what Symphonies they had were only of feveral Voices finging the same Melody only in a different Tone.

AFTER such evident Demonstrations, I think there needs no more to be said to prove that Symphonies of different Parts are a modern Improvement. From their rejecting the 3ds and 6ths out of the Number of Concords, the small Extent of their System being only Two Octaves, and having no Tone divided but that betwixt Mese and Paramese, we might argue that they had no different Parts: For the some simple Compositions of Parts might be contrived with these Principles, yet its hard to think they would lay the Foundations of that Practice, and carry it no surther, and much harder to believe they would never speak one Word of such an Art and Practice, where they profess to explain all the

the Parts of Musick. But for the Symphonies which we allow them to have had, you'll ask why these Writers don't speak of them, and why it feems fo incredible that they should have had the other Kind without being ever mentioned, when they don't mention these we allow? The Reason is plain, because the Musician's Business was only to compose the Melody, and therefore they wanted only Rules about that; but there was no Rule required to teach how several Voices might joyn in the same Song, for there is no Art in it: Experience taught them that this might be done in Unison or Octave; and pray what had the Writers more to fay about it? But the modern Symphony is a quite different Thing, and needs much to be explained both by Rules and Examples. But 'tis Time to make an End of this Point: I shall only add, That if plain Reason needs any Authority to support it, I can adduce many Moderns of Character, who make no Doubt to fay, That after all their Pains to know the true State of the ancient Musick, they could not find the least Ground to believe there was any fuch Thing in these Days as Musick in Parts. have named Perrault, and shall only add to him Kircher and Doctor Wallis, Authors of great Capacity and infinite Industry.

OUR next Comparison shall be of the Melody of the Ancients and Moderns; and here tomes in what's necessary to be said on the other Parts of Musick, viz. the Rythmus and Verse. In order to this Comparison, I shall distinguish

Melody

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Melody into vocal and instrumental. By the first I mean Musick set to Words, especially Verses; and by the other Musick composed only for Instruments without Singing. For the vocal you see by the Definition that Poetry makes a necessary Part of it: This was not only of ancient Practice, but the chief, if not their only Practice, as appears from their Definitions of Musick already explain'd. 'Tis not to be expected that I should make any Comparison of the ancient and modern Poetry; 'tis enough for my Purpose to observe, That there are admirable Performances in both; and if we come short of them, I believe 'tis not for want either of Genius or Application: But perhaps we shall be obliged to own that the Greek and Latin Languages were better contrived for pleasing the Ear. We are next to consider, that the Rythmus of their vocal Mufick was only that of the Poetry, depending altogether on the Verse, and had no other Forms or Variety than what the metrical Art afforded: This has been already shewn, particularly in explaining their musical Notes; to which add, That under the Head of Mutations, those who consider the Rythmus make the Changes of it no other than from one Kind of metrum or Verse to another, as from Jambick to Choraick: And we may notice too, That in the more general Sense, the Rythmus includes also their Dancings, and all the theatrical Action. I conclude therefore that their vocal Musick confished of Verses, set to musical Tones, and fung by one or more Voices

Voices in Choirs or alternately; fornetimes with and also without the Accompanyment of Inframents: To which we may add, from the last Article, That their Symphonies consisted only of feveral Voices performing the fame Song in different Tones as Unifon and Octave. For instrumental Musick (as I have defined it) 'tis not so very plain that they used any: And if they did, 'tis more than probable the Rythmus was only an Imitation of the poetical Numbers, and confifted of no other Measures than what were taken from the Variety and Kinds of their Verfes; of which they pretended a fufficient Variety for expressing any Subject according to its Nature and Property: And fince the chief Design of their Musick seems to have been to move the Heart and Passions, they needed no other Rythmus. I cannot indeed deny that there are many Passages which fairly infinuate their Practice upon Instruments without Singing; fo Athenaus says, The Synaulia was a Contest of Pipes performing alternately without singing. And Quintilian hath this Expression, If the Numbers and Airs of Musick have such a Vertue, how much more ought eloquent Words to have? That is to fay, the other has Virtue or Power to move us, without Respect to the Words. But if they had any Rythmus for infrumental Performances, which was different from that of their poetical Measures, how comes it to pass that those Authors who have been fo full in explaining the Signs by which their Notes of Musick were represented, speak not 988 A TREATISE CHAP. XIV.

not a Word of the Signs of Time for Instruments? Whatever be in this, it must be owned that Singing with Words was the most ancient Practice of Musick, and the Practice of their more solemn and perfect Entertainments, as appears from all the Instances above adduc ed, to prove the ancient Use and Esteem of Musick. And that it was the universal and common Practice, even with the Vulgar, appears by the pastoral Dialogues of the Poets, where the Contest is ordinarily about their Skill in Musick, and chief-

ly in Singing.

LET us next consider what the present Practice (among Europeans at least) consists of. We have, first, vocal Musick; and this differs from the ancient in these Respects, viz. That the Constitution of the Rythmus is different from that of the Verse, so far, that in setting Musick to Words, the Thing principally minded is, to accommodate the long and short Notes to the Syllables in fuch Manner as the Words may be well feparated, and the accented Syllable of every Word fo conspicuous, that what is fung may be distinctly understood: The Movement and Measure is also suited to the different Subjects, for which the Variety of Notes, and the Constitutions or Modes of Time explained in Chap. 12, afford sufficient means. Then we differ from the Ancients in our instrumental Accompanyments, which compole Symphonies with the Voice, some in Unifon, others making a distinct Melody; which produces a ravishing Entertainment they were not blest with, or at least with

without which we should think ours imperfect. Then there is a delightful Mixture of pure instrumental Symphonies, performed alternately with the Song. Lastly, We have Compositions fitted altogether for Instruments: The Design whereof is not fo much to move the Passions, as to entertain the Mind and please the Fancy with a Variety of Harmony and Rythmus; the principal Effect of which is to raise Delight and Admiration. This is the plain State of the ancient and modern Musick, in respect of Practice: But to determine which of them is most perfect, will not perhaps be fo eafily done to fatisfie every Body. Tho' we believe theirs to have been excellent in its Kind, and to have had noble Effects; this will not please some, unless we acknowledge ours to be barbarous, and altoger ther ineffectual. The Effects are indeed the true Arguments; but how shall we compare these, when there remain no Examples of ans cient Composition to judge by? so that the Defenders of the ancient Musick admire a Thing they don't know; and in all Probability judge not of the modern by their personal Acquain-tance with it, but by their Fondness for their own Notions. Those who study our Musick, and have well tuned Ears, can bear Witness to its noble Effects: Yet perhaps it will be replied, That this proceeds from a bad Tafte, and something natural, in applauding the best Thing we know of any Kind. But let any Body produce a better, and we shall heartily applaud it. They bid us bring back the ancient Musicians,

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and then they'll effectually shew us the Difference; and we bid them learn to understand the modern Musick, and believe their own Senses: In short we think we have better Reason to determine in our own Favours, from the Effects we actually feel, than any Body can have from a Thing they have no Experience of, and can pretend to know no other Way than by Report: But we shall consider the Pretences of each Party a little nearer. I have already observed, that the principal End the Ancients proposed in their Musick, was to move the Passions; and to this purpose Poetry was a necessary Ingredient. We have no Dispute about the Power of poetical Compositions to affect the Heart, and move the Passions, by such a strong and lively Reprefentation of their proper Objects, as that noble Art is capable of: The Poetry of the Ancients we own is admirable; and their Verses being fung with harmonious Cadences and Modulations, by a clear and fweet Voice, fupported by the agreeable Sound of fome Instrument, in fuch Manner that the Hearer understood every Word that was faid, which was all delivered with a proper Action, that is, Pronunciation and Geftures fuitable to, or expressive of the Subject, as we also suppose the Kind of Verse, and the Modulation applied to it was; taking their vocal Musick in this View, we make no Doubt that it had admirable Effects in exciting Love, Pity, Anger, Grief, or any Thing elfe the Poet had a Mind to: But then they must be allowed to affirm, who pretend to have the Experience of it,

it, That the modern Musick taking it in the fame Senie, has all these Effects. Whatever Truth may be in it, I shall pass what Doctor Wallis alledges, viz. That these ancient Effects were most remarkably produced upon Rusticks, and at a Time when Musick was new, or a very rare Thing: But I cannot however miss to observe with him, That the Passions are easily wrought upon. The deliberate Reading of a Romance well written will produce Tears, Joy, or Indignation, if one gives his Imaginations a Loofe; but much more powerfully when attended with the Things mentioned: So that it can't be thought fo very mysterious and wonderful an Art to excite Passion, as that it should be quite loft. Our Poets are capable to express any moving Story in a very pathetick Manner: Our Musicians too know how to apply a fuitable Modulation and Rythmus: And we have those who can put the Whole in Execution; fo that a Heart capable of being moved will be forced to own the wonderful Power of modern Musick: The Italian and English Theatres afford sufficient Proof of this; so that I believe, were we to collect Examples of the Effects that the acting of modern Tragedies and Operas have produced, there would be no Reason to fay we had lost the Art of exciting Passion. But 'tis needless to insist on a Thing which so many know by their own Experience. If some are obstinate to affirm, That we are still behind the Ancients in this Art, because they have never felt such Effects of it; I shall ask them if thev

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they think every Temper and Mind among the Ancients was equally disposed to relish, and be moved by the same Things? If Tempers distered then, why may they not now, and yet the Art be at least as powerful as ever? Again have we not as good Reason to believe those who affirm they feel this Influence, as you who say you have never experienced it? And if you put the Matter altogether upon the Authority of others, pray, is not the Testimony of the Living for the one, as good as that of the

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But still there are Wonders pretended to have been performed by the ancient Musick, which we can produce nothing like; fuch as those amazing Transports of Mind, and hurrying of Men from one Passion to another, all on a sudden, like the moving of a Machine, of which we have so many Examples in History, See Page 495. For these I shall answer, That what we teckon incredible in them may justly be laid upon the Historians, who frequently aggravate Things beyond what's strictly true, or even their Credulity in receiving them upon weak Grounds; and most of these Stories are delivered to us by Writers who were not themselves Witnesses of them, and had them only by Tradition and common Report. If nothing like this had ever been justly objected to the ancient Historians, Ishould think my felf obliged to find another Answer: But since tis so, we may be allowed to doubt of these Facts, or suspect at least that they are in a great Degree hyperbolical, Consider but

Circumstances of some of them as they are told, and if they are literally true, and can be accounted for no other Way but by the Power of Sound, I must own they had an Art which is loft: For Example, the quelling of a Sedition; let us represent to our selves a furious Rabble, envenomed with Discontent, and enraged with Oppression; or let the Grounds of their Rebellion be as imaginary as you pleafe, still we must confider them as all in a Flame; suppose next they are attacked by a skilful Musician, who addresses them with his Pipe or Lyre; how likely is it that he shall perswade them by a Song to return to their Obedience, and lay down their Arms? Or rather how probable is it that he may be torn to Pieces, as a folemn Mocker or their just Resentment? But that I may allow some Foundation for fuch a Story, I shall suppose a Man of great Authority for Virtue, Wisdom and the Love of Mankind, comes to offer his humble and affectionate Advice to fuch a Company; I suppose too, he delivers it in Verse, and perhaps fings it to the Sound of his Lyre, (which feems to have been a common Way of delivering publick Exhortations in more ancient Times, the Musick being used as a Means to gain their Attention.) I don't think it impoffible that this Man may perfwade them to Peace, by representing the Danger they run, aggravating the Mischief they are like to bring upon themselves and the Society, or also correcting the falfe Views they may have had of Things: But then will any Body fay; all this

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is the proper Effect of Musick, unless Reasoning be also a Part of it? And must this be an Example of the Perfection of the ancient Art, and its Preference to ours? In the same Manner may other Instances alledged be accounted for, fuch as Pythagoras's diverting a young Man from the Execution of a wicked Design, the Reconcilement of Two inveterate Enemies, the curing of Clytemnestra's vicious Inclinations, &c. Horace's Explication of the Stories of Orpheus and Amphion, makes it probable we ought to explain all the rest the same Way. For the Story of Timotheus and Alexander, as commonly represented, it is indeed a very wonderful one, but I doubt we must here allow fomething to the Boldness or Credulity of the Historian: That Timotheus, by finging to his Lyre, with moving Gesture and Pronunciation, a well composed Poem of the Atchievements of some renowned Hero, as Achilles, might awaken Alexander's natural Paffion for warlike Glory, and make him express his Satisfaction with the Entertainment in a remarkable Manner, is nowife incredible: We are to consider too the Fondness he had for the Iliad, which would dispose him to be moved with any particular Story out of that: But how he should forget himself so far, as to commit Violence on his best Friend, is not so easily accounted for, unless we suppose him at that Time as much under the Power of Bacchus as of the Muses: And that a foster Theme sung with equal Art, should please a Hero who was not

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not infensible of Venus's Influences is no Mystery, especially when his Mistress was in Company: But there is nothing here above the Power of modern Poetry and Musick, where it meets with a Subject the same Way disposed, to be wrought upon: To make an End of this, must observe, that the Historians, by faying too much, have given us Ground to believe very little. What do you think of curing a raging Pestilence by Musick? For curing the Bites of Serpents, we cannot fo much doubt it, fince that of the Tarantula has been cured in Italy. But then they have no Advantage in this Instance : And wemust mind too that this Cure is not performed by exquisite Art and Skill in Musick; it does not require a Correlli or Valentini, but is performed by Strains discovered by random Trials without any Rule: And this will ferve for an Answer to all that's alledged of the Cure of Diseases by the ancient Musick.

"Tis Time to bring this Comparison to an End; and after what's explained I shall make no Dissiculty to own, that I think the State of Musick is much more perfect now than it was among the ancient Greeks and Romans. The Art of Musick, and the true Science of Harmony in Sounds is greatly improven. I have allowed their Musick (including Poetry and the theatrical Action) to have been very moving; but at the same Time I must say, their Melody has been a very simple Thing, as their System or Scale plainly shews, whose Difference from the

modern I have already explained:

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And the confining all their Rythmus to the poetical Numbers, is to me another Proof of it, and shews that there has been little Air in their Musick; which by this appears to have been only of the recitative Kind, that is, only a more musical Speaking, or modulated Elocution; the Character of which is to come near Nature, and be only an Improvement of the natural Accents of Words by more pathetick or emphatical Tones; the Subject whereof may be either Verse or And as to their Instruments of Mufick, for any Thing that appears certain and plain to us, they have been very simple. Indeed the publick Laws in Greece gave Check to the Improvement of the Art of Harmony, because they forbade all Innovations in the primitive simple Musick; of which there are abundance of Testimonies, some whereof have been mentioned in this Chapter, and I shall add what Plato fays in his Treatife of the Laws, viz. That they entertain'd not in the City the Makers of fuch Instruments as have many Strings, as the Trigonus and Pectis; but the Lyra and Cithara they used, and allowed also some simple Fiftula in the Country. But 'tis certain, that primitive Simplicity was altered; fo that from a very few Strings, they used a greater Number: But there is much Uncertainty about the Use of them, as whether it was for mixing their Modes, and the Genera, or for striking Two Chords together as in the Magadis. Since I have mentioned Instruments, I must observe Two Things, First, That they pretend to have had Tibia of diffedifferent Kinds, whose specifick Sounds were excellently chosen for expressing different Subjects. Then, there is a Description of the Organum hydraulicum in Tertullian, which some adduce to prove how perfect their Instruments were. - Specta portentosam Archimedis munificentiam; organum hydraulicum dico, tot membra, tot partes, tot compagines, tot itinera vocum, tot compendia sonorum, tot commercia modorum, tot acies tibiarum, & una moles erunt omnia; where he had learnt this pompous Description of it I know not; for one can get but a very obscure Idea of it from Vitruvius, even after Kircher and Voffius's Explications. But I hope it will not be pretended to have been more perfect than our modern Organs: And what have they to compare of the stringed Kind, with our Harpsichords; and all the Instruments that are struck with a Bow?

After all, if our Melody or Songs are only equal to the Ancients, I hope the Art of Musick is not lost as some pretend. But then, what an Improvement in the Knowledge of pure Harmony has been made, since the Introduction of the modern Symphonies? Here it is, that the Mind is ravished with the Agreement of Things seemingly contrary to one another. We have here a Kind of Imitation of the Works of Nature, where different Things are wonderfully joyned in one harmonious Unity: And as some Things appear at first View the farthest removed from Symmetry and Order, which from the Course of Things we learn to be absolutely necessary for the Perfecti-

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on and Beauty of the Whole; fo Discords being artfully mixed with Concords, make a more perfect Composition, which surprises us with Delight. If the Mind is naturally pleafed with perceiving of Order and Proportion, with comparing feveral Things together, and difcerning in the midst of a seeming Consusion, the most perfect and exact Disposition and united Agreement; then the modern Concerts must undoubtedly be allowed to be Entertainments worthy of our Natures: And with the Harmony of the Whole we must consider the surprising Variety of Air, which the modern Constitutions and Modes of Time or Rythmus afford; by which, in our instrumental Performances, the Sense and Imagination are so mightily charmed. Now, this is an Application of Musick to a quite different Purpose from that of moving Passion: But is it rea-Sonable upon that Account, to call it idle and infignificant, as fome do, who I therefore fufpect are ignorant of it? It was certainly a noble Use of Musick to make it subservient to Morality and Virtue; and if we apply it less that Way, I believe 'tis because we have less Need of fuch Allurements to our Duty: But whatever be the Reason of this, 'tis enough to the present Argument, that our Musick is at least not inferior to the ancient in the pathetick Kind: And if it be not a low and unworthy Thing for us to be pleased with Proportion and Harmony, in which there is properly an intellectual Beauty, then it must be confessed, that the modern Mufick is more perfect than the ancient. But why must

must the moving of particular Passions be the only Use of Musick? If we look upon a noble Building, or a curious Painting, we are allowed to admire the Design, and view all its Proportions and Relation of Parts with Pleasure to our Understandings, without any respect to the Passions. We must observe again, that there is scarce any Piece of Melody that has not some general Influence upon the Heart; and by being more fprightly or heavy in its Movements, will have different Effects; tho' it is not designed to excite any particular Passion, and can only be said in general to give Pleasure, and recreate the Mind. But why should we dispute about a Thing which only Strangers to Musick can speak ill of? And for the Harmony of different Parts, the Defenders of the ancient Musick own it to be a vahable Art, by their contending for its beingancient: Let me therefore again affirm, that the Moderns have wonderfully improven the Art of Musick. It must be acknowledged indeed, that to judge well, and have a true Relish of our more elaborate and complex Mufick, or to be fensible of its Beauty, and taken with it, requires a peculiar Genius, and much Experience, without which it will feem only a confused Noise; but I hope this is no Fault in the Thing. If one altogether ignorant of Painting looks upon the most curious Piece, wherein he finds nothing extraordinary moving to him, because the Excellency of it may ly in the Design and admirable Proportion and Situation of the Parts which he takes no Notice of: Must we there-P p 4

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fore fay, it has nothing valuable in it, and capable to give Pleasure to a better Judge? What, in Musick or Painting, would feem intricate and confused, and so give no Satisfaction to the unskilled, will ravish with Admiration and Delight, one who is able to unravel all the Parts. observe their Relations, and the united Concord But now, if this be fuch a real of the Whole. and valuable Improvement in Musick, you'll ask, How it can be thought the Ancients could beignorant of it, and fatisfy themselves with such a fimple Musick, when we consider their great Perfection in the Sifter Arts of Poetry and Painting, and all other Sciences. I shall answer this by asking again, How it comes that the Ancients left us any thing to invent or improve? And how comes it that different Ages and Nations have Genius and Fondness for different Things. The Ancients studied only how to move the Heart, to which a great many Things necessarily concurred, as Words, Tune and Action; and by these we can still produce the same Effects; but we have also a new Art, whose End is rather to entertain the Understanding, than to move particular Passions. What Connection there is betwixt their improving other Sciences and this, is not fo plain as to make any certain Conclusion from it. And as to their Painting, there have been very good Reasons alledged to prove, That they followed the same Taste there as in the Musick, i. e. the simple obvious Beauties, of which every Body might judge and be fensible. Their End was to please and move the People, which is betd

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better done by the Senses and the Heart than by the Understanding; and when they found sufficient Means to accomplish this, why should we wonder that they proceeded no further, especially when to have gone much beyond, would likely have losed their Design. But, fay you, this looks as if they had been fensible there were Improvements of another Kind to be made: Suppose it was so, yet they might stop when, their principal End was obtained. And Plutarch fays as much, for he tells us it was not Ignorance that made the ancient Musick so simple, but it was fo out of Politick : Yet he complains, that in his own Time, the very Memory of the ancient Modes that had been fo useful in the Education of Youth, and moving the Passions was loft thro' the Innovations and luxurious Variety introduced by later Musicians; and now, when a full Liberty feems to have been taken. may we not wonder that so little Improvement was made, or at least so little of it explained and recorded to us by these who wrote of Musick. after fuch Innovations were fo far advanced.

I shall end this Dispute, which is perhaps too tedious already, with a short Consideration of what the boldest Accuser of the modern Musick, Isaac Vossius, says against it, in his Book de poematum cantu & viribus Rythmi. He observes, what a wonderful Power Motion has upon the Mind, by Communication with the Body; how we are pleased with rythmical or regular Motion; then he observes, that the ancient Greeks and Latins perceiving this, took an infinite

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Pains to cultivate their Language, and make it as harmonious, especially in what related to the Rythmus, or Number, and Combination of long and short Syllables, as possible; to this End particularly were the pedes metrici invented, which are the Foundations of their Versification; and this he owns was the only Rythmus of their Musick, and so powerful, that the whole Effect of Mulick was ascribed to it, as appears, says he, by this Saying of theirs, το πῶν παρά μεσιxõig à puguès: And to prove the Power attributed to the Rythmus, he cites several other Paffages. That it gives Life to Musick, especially the pathetick, will not be denied; and we fee the Power of it even in plain Profe and Oratory: But to make it the Whole, is perhaps at tributing more than is due: I rather reckon the Words and Senfe of what's fung, the principal Ingredient; and the other a noble Servant to them, for raising and keeping up the Attention, because of the natural Pleasure annexed to these Sensations. 'Tis very true, that there is a Connection betwixt certain Passions, which we call Motions of the Mind, and certain Motions in our Bodies; and when by any external Motion these can be imitated and excited, no doubt we shall be much moved; and the Mind, by that Influence, becomes either gay, foft, brisk or drowfy: But how any particular Passion can be excited without fuch a lively Reprefentation of its proper Object, as only Words afford, is not very intelligible; at least this appears to me the most just and effectual Way. But let us the

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hear what Notion others had of this Matter, Quintilian fays, If the Numbers of Musick have such Influence, how much more ought eloquent Words to have? And in all the ancient Musick the greatest Care was taken, that not a Syllable of the Words should be lost, for spoiling the Sense, which Vossius himself observes and owns. Pancirollus, who thinks the Art loft, ascribes the chief Virtue of it to the Words. - Siguidem una cum melodia integra percipiebantur verba: And the very Reason he gives, that the modern Musick is less perfect, is, that we hear Sounds without Words, by which fays he, the ear is a little pleased, without any Entertainment to the Understanding: But all this has been considered already. Vossius alledges the mimick Art, to prove, that the Power of Motion was equal to the most eloquent Words; but we shall be as much straitned to believe this, as the rest of their Wonders. Let them believe it who will, that a Pantomime had Art to make himself easily understood without Words, by People of all Languages: And that Roscius the Comedian, could express any Sentence by his Gestures, as fignisicantly and veriously, as Cicero with all his Oratory. Whatever this Art was, 'tis loft, and perhaps it was fomething very furprifing; but tis hard to believe these Stories literally. However to the Thing in Hand, we are concerned only to consider the musical or poetical Rythmus.

Vossius says, that Rythmus which does not contain and express the very Forms and Figures

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of Things, can have no Effect; and that the ancient poetical Numbers alone are justly contrived for this End. And therefore the modern Languages and Verse are altogether unfit for Musick; and we shall never have, fays he, any right vocal Musick, till our Poets learn to make Verses that are capable to be fung, that is, as he explains it, till we new model our Languages, restore the ancient metrical Feet, and banish our barbarous Rhimes. Our Verses, says he, run all as it were on one Foot, without Distinction of Members and Parts, in which the Beauty of Proportion is to be found; therefore he reckons, that we have no Rythmus at all in our Poetry; and affirms, that we mind nothing but to have fuch a certain Number of Syllables in a Verse, of whatever Nature, and in whatever Order. Now, what a rash and unjust Criticism is this! if it was so in his Mother Tongue, the Dutch, I know not; but I'm certain it is otherwise in English. 'Tis true, we don't follow the metrical Composition of the Ancients; yet we have fuch a Mixture of strong and fost, long and short Syllables, as makes our Verses slow, rapid, fmooth, or rumbling, agreeable to the Subject. Take any good English Verse, and by a very small Change in the Transposition of a Word or Syllable, any Body who has an Ear will find, that we make a very great Matter of the Nature and Order of the Syllables. But why must the ancient be the only proper Metre for Poetry and Musick? He says, their Odes were fung, as to the Rythmus, in the same Manner

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as we scan them, every pes being a distinct Bar or Measure, separate by a distinct Pause; but in the bare Reading, that Distinction was not accurately observed, the Verse being read in a more continuous Manner. Again he notices, that after the Change of the ancient Pronunciation, and the Corruption of their Language, the Musick decayed till it became a poor and infignificant Art. Their Odes had a regular Return of the same Kind of Verse; and the same Quantity of Syllables in the fame Place of every simiar Verse: But there's nothing, says he, but Confusion of Quantities in the modern Odes; so that to follow the natural Quantity of our Syllables, every Stanza will be a different Song, otherwise than in the ancient Verses: - (He should have minded, that every Kind of Ode was not of this Nature; and how heroick Verses were fung, if this was necessary, I cannot see, because in them the Dactylus and Spondeus are fometimes in one Place of the Verfe, and fometimes in another.) But instead of this, he fays, the Moderns have no Regard to the natural Quantity of the Syllables, and have introduced an unnatural and barbarous Variety of long and short Notes, which they apply without any Regard to the Subject and Sense of the Verse, or the natural Pronunciation: So that nothing can be understood that's fung, unless one knows it before; and therefore, no wonder, fays he, that our vocal Musick has no Effects. Now here is indeed a heavy Charge, but Experience gives me Authority to affirm it to be absolutely false. We

have vocal Musick as pathetick as ever the ancient was. If any Singer don't pronounce intelligibly, that is not the Fault of the Musick, which is always fo contrived, as the Senfe of the Words may be distinctly perceived. But this is impossible, fays he, if we don't follow the natural Pronunciation and Quantity; which is I think, precariously faid; for was the Singing of the ancient Odes by separate and distinct Meafures of metrical Feet, in which there must frequently be a Stop in the very Middle of a Word, Was this I fay the natural Pronunciation, and the Way to make what was fung best understood? Himself tells us, they read their Poems otherwife. And if Practice would make that distinct enough to them, will it not be as sufficient in the other Cafe. Again, to argue from what's strictly natural, will perhaps be no Advantage to their Cause; for don't we know, that the Ancients admitted the most unnatural Positions of Words, for the fake of a numerous Stile, even in plain Profe; and took still greater Liberties in Poetry, to depart from the natural Order in which Ideas ly in our Mind; far otherwise than it is in the modern Languages, which will therefore be moe eafily and readily understood in Singing, if pronounced distinctly, than the ancient Verse could be, wherein the Construction of the Words was more difficult to find, because of the Transpositions. Again the Difference of long and fhort Syllables in common Speaking, is not accurately observed; not even in the ancient Languages; for Example, in common Speaking, who

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who can' diffinguish the long and short Syllables in thef e Words, satis, nivis, misit. The Sense of a Word generally depends upon the right Pronunciation of one Syllable, or Two at most in very long Words; and if thefe are made conspicuous, and the Words well separated by a right Application of the long and short Notes, as we certainly know to be done, then we follow the natural Pronunciation more this Way than the other. If 'tis replied, that fince we pretend to a poetical Rythmus, fuitable to different Subjects, why don't we follow it in our Musick? I shall answer, that tho' that Rythmus is more distinguished in the Recitation of Poems, yet our musical Rythmus is accommodated also to it; but with such Liberty as is neceffary to make good Melody; and even to produce stronger Effects than a simple Reciting can do; and I would ask, for what other Reafonthe Ancients fung their Poems in a Manner different from the bare reading of them? Still he tells us, that we want the true Rythmus, which can only make pathetick Musick; and if there is any Thing moving in our Songs, he fays, 'tis only owing to the Words; fo that Profe may be fung as well as Verse: That the Words ought naturally to have the greatest Influence, has been already confidered; and I have feen no Reason why the ancient poetical Rythmus should have the only Claim to be pathetick; as if they had exhausted all the Combinations of long and short Sounds, that can be moving or agreeable: But indeed the Question is about

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about Matter of Fact, therefore I shall appeal to Experience, and leave it; after I have minded you, that by this Defence of the modern Musick, I don't say it is all alike good, or that there can be no just Objection laid against any of our Compositions, especially in the setting of Musick to Words; I only say, we have admirable Compositions, and that the Art of Musick, taken in all that it is capable of; is more perfect than it was among the old Greeks and Romans, at least for what can possibly be made appear.

FINIS.





